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Final Technical Report

INVESTIGATION OF DREDGING IMPACTS ON COMMERCIAL AND RECREATIONAL FISHERIES AND ANALYSIS OF AVAILABLE MITIGATION MEASURES TO PROTECT AND PRESERVE RESOURCES



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Prepared for

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Minerals Management Service

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Statement of Disclaimer

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FINAL TECHNICAL REPORT

INVESTIGATION OF DREDGING IMPACTS ON COMMERCIAL AND RECREATIONAL FISHERIES AND ANALYSIS OF AVAILABLE MITIGATION MEASURES TO PROTECT AND PRESERVE RESOURCES

September 2007

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Dr. Bruce Tomlinson of Emu Ltd served as Project Manager. He was responsible for project coordination and client liaison. He also co-authored Sections 1.0 (Introduction) and 5.0 (Recommendations) and was Co-Editor of the report.

Dr. John S. Petterson of Impact Assessment, Inc. (IAI) served as Principal Investigator. He co-authored Sections 1.0 (Introduction), 2.0 (U.S. Survey of Dredging Impacts), 4.0 (Comparison of U.S. and U.K. mitigation measures) and 5.0 (Recommendations), and was Co-Editor of the report. He also undertook ethnographic interviews with fishermen and ethnographic fieldwork on dredging vessels, and was involved in the production of mitigation measures.

Other Emu Ltd personnel who participated in the project included J. Lewis who co-authored Sections 3.0 (U.K. Survey of Dredging Impacts), 4.0 (Comparison of U.S. and U.K. Mitigation Measures) and 5.0 (Recommendations). He also co-ordinated the worldwide literature search, was involved in the Government regulation review and the production of mitigation measures, supervised the development of spatial conflict maps and associated conflict ranking system, and participated in the site visits to government, industry and fishing bodies in the U.K. Rebecca Cooke was responsible for the management of spatial data files and conflict mapping. Claire Espinasse co-authored Section 3.0 U.K. Survey of Dredging Impacts, undertook the literature search, participated in the site visits to government, industry and fishing bodies in the U.K. and was responsible for report compilation and editorial assistance during production of the report.

Other IAI personnel who contributed to the project included E. W. Glazier, who was involved in the Government regulation review, and participated in the site visits to government, industry and fishing bodies in the U.S. He also undertook ethnographic interviews with fishermen and ethnographic fieldwork on dredging vessels. He co-authored Sections 4.0 (Comparison of U.S. and U.K. Mitigation Measures) and 5.0 (Recommendations). P. Goode was involved in the ethnographic interviews with fishermen, ethnographic fieldwork on dredging vessels and identification of U.S. offshore areas at risk. L. Stanley undertook the literature search and was responsible for editorial assistance during production of the report.

R. Nairn and T. Kenny of Baird & Associates (Baird) were also involved in the production of mitigation measures. R. Nairn was responsible for the project liaison with Baird and partners. T. Kenny was the dredging specialist on the Baird project team, providing advice on dredging procedures and activities in the U.S.

I. Selby of Hanson Aggregates Marine Ltd was acting in an advisory role within the project team and facilitated dredging-based fieldwork and meetings/interviews with the U.K. marine dredging industry.

TABLE OF CONTENTS

Tables

Figures

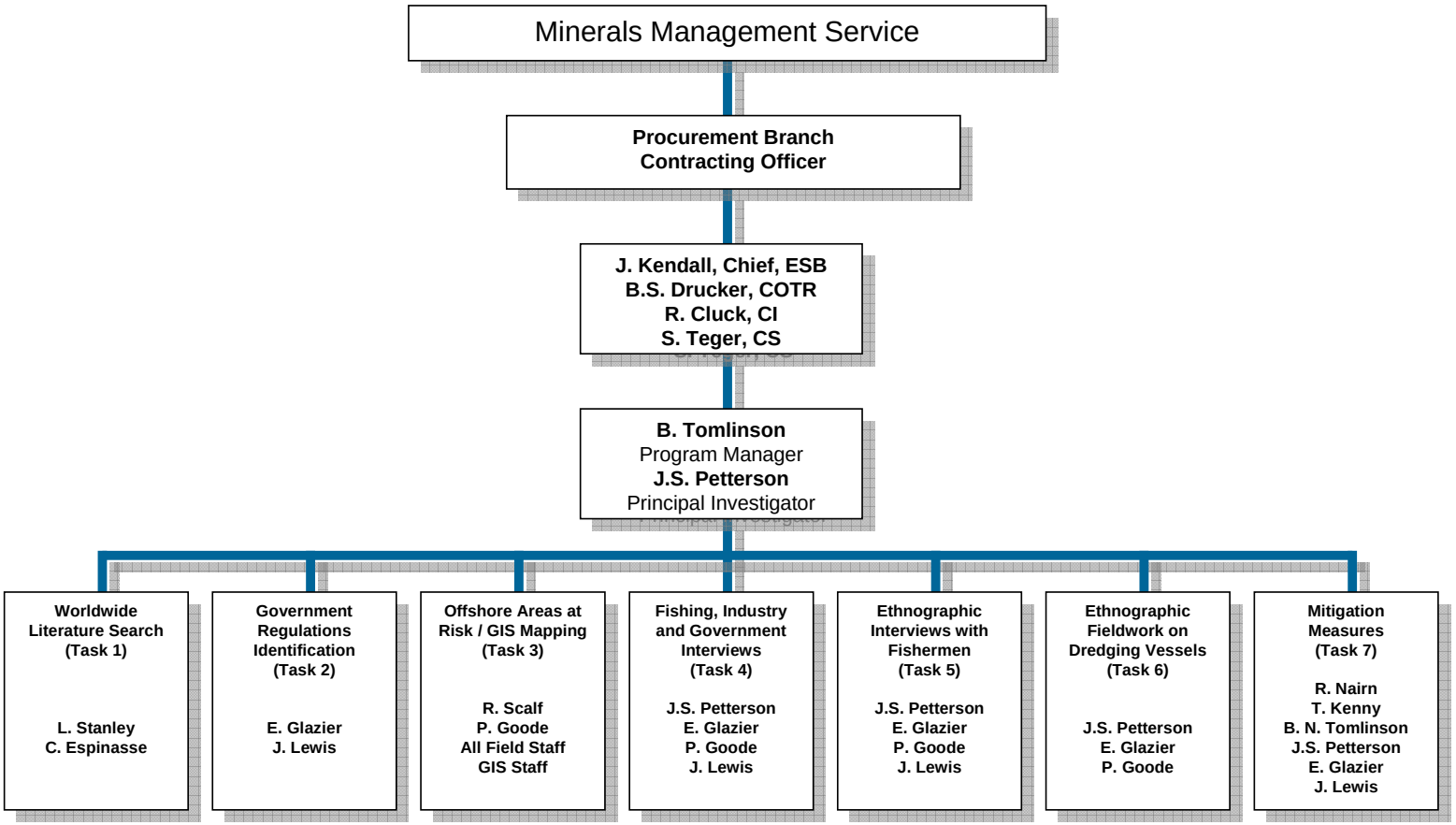
List of Acronyms

BMAPA	British Marine Aggregates Producers Association
BMP	Beach Management Program
CBIA	Coastal Barrier Improvement Act
CBRS	Coastal Barrier Resources System
CEFAS	Centre for the Environment, Fisheries and Aquaculture Science
CERB	Coastal Engineering Research Board
CERC	Coastal Engineering Research Center
CFP	Common Fisheries Policy
CIS	Coastal Impact Study
CZMA	Coastal Zone Management Act
DCLG	Department for Communities and Local Government
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department of Environment Transport and the Regions
EA	Environmental Assessment
EEC	Eastern English Channel
EFH	Essential Fish Habitat
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ES	Environmental Statement
EMS	Electronic Monitoring Systems
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FLN	Final Leasing Notice
GOM	Gulf of Mexico
GPG	Good Practice Guidance
HSB	Hastings Shingle Bank
IAI	Impact Assessment, Inc.
ICES	International Council for the Exploration of the Seas
IGVP	Interim Government View Procedure
LPUE	Landings Per Unit Effort
MAGP	Multi-Annual Guidance Programs
MLS	Minimum Landing Size
MMG1	Marine Minerals Guidance Note 1
MMS	Minerals Management Service
MMP	Marine Minerals Program
MPS	Mineral Policy Statement
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NFSA	National Federal of Sea Anglers
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRMO	Natural Resources Management Office
NRC	National Research Council
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act Amendments
ODPM	Office of the Deputy Prime Minister
PCCBA	Port Canaveral Charter Boat Association
PLN	Proposed Leasing Notice
RFII	Request for Information and Interest
SSC	Suspended Sediment Concentrations
TSHD	Trailing Suction Hopper Dredgers
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey

Terminology		Definition
U.S. Terminology	U.K. Terminology	
Environmental Assessment	Environmental Impact Assessment	Process of predicting and evaluating the effects of an action or series of actions on the environment, then using the conclusions as a tool in planning and decision-making (Pritchard, 1996)
Environmental Assessment Report	Environmental Statement	A report that documents the information required to evaluate the environmental impact of a project. It informs decision makers and the public of the reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the environment (EIA, 2007).
Environmental Impact Statement	N/A	The primary purpose of an environmental impact statement (EIS) is to serve as an action-forcing device to insure that the policies and goals defined in the Environmental Quality Improvement Act of 1970 are infused into the ongoing programs and actions of the Federal Government. An EIS is used by Federal officials in conjunction with other relevant material to plan actions and make decisions (CEQ, 1978).

Investigation of Dredging Impacts on Commercial and Recreational Fisheries

Project Organization and Coordination



Investigation of Dredging Impacts on Commercial and Recreational Fisheries and Analysis of Available Mitigation Measures to Protect and Preserve Resources

Final Technical Report

1.0 INTRODUCTION

1.1 Overview of Project

As onshore and nearshore sand supplies continue to dwindle, it is likely that Outer Continental Shelf (OCS) areas increasingly will serve as "sand borrowing" sites. Although an essential component of beach re-nourishment projects, offshore sand dredging operations can deleteriously impact resident commercial and recreational fisheries. Such operations may directly affect the biodiversity, biomass, and population density of a fishery, or result in the spatial exclusion or temporary suspension of commercial and/or recreational fishing of the area surrounding the dredging activity; benthic communities also may be indirectly affected (Drucker *et al.*, 2003, pp. 33-34; Lindeman and Snyder 1999). Consequently, conflict arising from the interaction between OCS dredging activities and ongoing recreational and commercial fishing in the vicinity may also increase (Murray 1995). Established points of conflict include: decreased catch; reduced income; damaged gear; loss of landing area; and the physical exclusion of fishing vessels from licensed extraction areas (Ahmad 2003; Dickson 1975). However, some fisheries may also benefit from navigational or maintenance dredging activities. For instance, ongoing dredging of inlets and navigational channels has afforded fishing vessels greater access to fishing grounds, harbors, and points of landings. Additionally, dredging in coastal estuaries may enhance water flow in previously constricted or polluted areas, thereby enhancing the health of juvenile fish habitat.

In 1992 MMS began working with state and local governments to locate suitable sand resources. By instituting and overseeing regulatory measures that safeguard both the marine and human environment from the anticipated impacts of dredging, local concerns regarding shoreline alteration can be mitigated.

This report describes the development, execution, and immediate socio-economic impacts of sand mining at three offshore sites: two in the U.S. and one in the United Kingdom (U.K.). The first U.S. site–Cape Canaveral/Cocoa Beach–is located in Brevard County on the central east coast of Florida. The second U.S. site–the Naples, Park Shore, and Vanderbilt Beach areas–is located in Collier County on the southwest coast of Florida (Figure 1). The U.K. site is in Hastings Shingle Bank (HSB), a large shingle bank feature located approximately eight miles south of Hastings on the south east English coast (Figure 2). These three sites were selected for this study because they represent a range of issues germane to contemporary dredging operations that can impact commercial and recreational fisheries in the industrial world. This report first identifies and describes these issues and then suggests measures that may mitigate potential and real conflict between offshore dredge purveyors and fishermen who rely on shared waterways and resources for their livelihood.

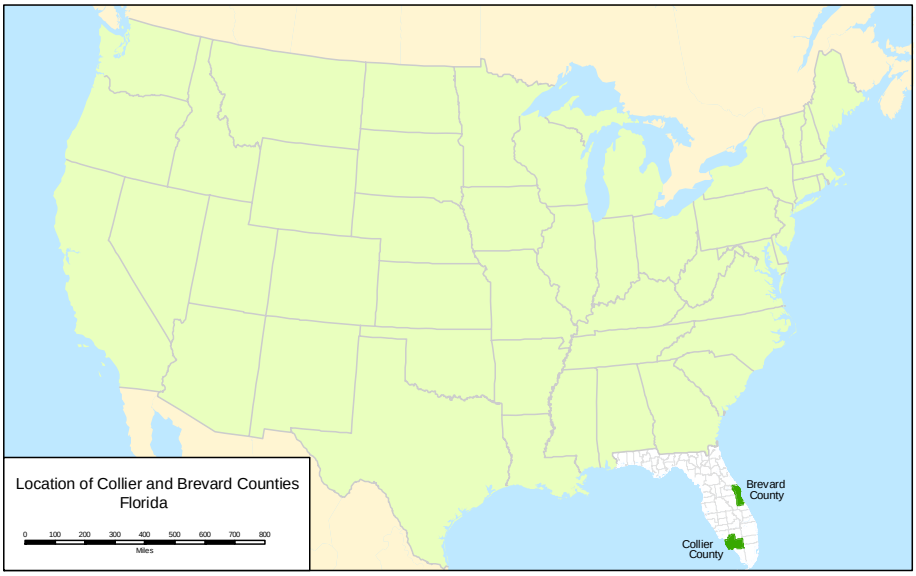


Figure 1. Location of U.S. Case Study Sites: Brevard County and Collier County (IAI, 2006).

Figure 2. Location of U.K. Study Site: Hastings, England (IAI, 2006).

1.2 Project Goals and Objectives

The overarching objective of this research is to provide MMS with information regarding the extent and nature of the impact of sand mining projects on commercial and recreational fishermen whose vessels share water space with dredge operators. This study achieves the following objectives, as per the description, specifications, and statement of work of contract #1435–01-04-34396, Section C:

Key Objectives of Study

- To provide a background that assists in determining environmental impacts of offshore dredging on resident commercial and recreational fisheries;
- To provide a comprehensive list of detailed mitigation measures that can be applied to avoid adverse impacts to fisheries that may be present in OCS sand resource areas, regardless of geographic location;
- To identify, develop, and evaluate specific proposals to mitigate or resolve potential spatial conflicts between the commercial and recreational fishing industries and the development of OCS sites as long-term sand borrow areas;
- To explore the possibilities for creating or revising institutional linkages that might facilitate communication and cooperation between the various fishing components, MMS, and the dredging industry in the future.

The project methodology emphasizes the role of sand mining operations in: (1) impacting the offloading, processing, and wholesale and retail sales of Florida's southwest seafood product; (2) changing participation levels or activities in fisheries located in the state and federal jurisdiction waters of southwestern Florida; and (3) introducing measures for mitigating operational impacts on user-groups of waters shared by dredge operations and commercial fishermen. These objectives each required specific research methods and sources of data collection suited to each domain. Tables 1a, 1b, and 1c detail these data collection techniques. A more detailed description of data collection methods follows.

Table 1(a)
Data Collection Techniques Based on Required General Category of Information to Meet Main Objectives

OBJECTIVE 1	Establish Background of Environmental Impacts of Offshore Dredging on Resident Commercial and Recreational Fisheries in Brevard and Collier Counties and Surrounding Area.
Location In Report	**Sections 1, 2, and 3**
General Category of Information Need	**Source and Research Methods**
Background/historical context of fishermen in Brevard and Collier Counties and surrounding areas to establish user-groups and historical issues.	Collection/analysis of secondary data, public business listings, and historical literature.
Spatial use maps of both dredge operators and fishermen.	Collection of general coordinates used by fishermen in determining fishing grounds and navigation in offshore waters; GPS markings of dredge work onshore; GPS markings of fishing sites offshore; generation of spatial maps using GIS techniques.
Report on nature and intensity of individual fisheries. Identification of mitigation measures implemented to avoid conflict.	Collection/analysis of primary data, including field notes, discussions with key industry persons, site visits to fishing vessels. Collection/analysis of secondary data, including local newspaper articles.
Report on nature and intensity of dredge operations. Implementation of mitigation measures to avoid conflict.	Collection/analysis of primary data, including field notes, discussions with key industry persons such as dredge company officials, vessel operators, local government officials, and the general public, field visits to weekly public forums attended by industry and government figures to discuss local dredge operations, and site visits to dredge vessels. Collection/analysis of secondary data, including local newspaper articles.
Report on nature and intensity of conflict/cooperation between dredge operators and resident fishermen.	Field visits to weekly/monthly public meetings attended by industry and government figures to discuss local dredge operations were discussed.
Report on regulatory environment of sand-mining in Collier County.	Collection/analysis of secondary data, including government documents on rules and regulations; conversations with key government persons.
History of sand-mining in Florida and Collier County.	Collection/analysis of secondary data, including historical documents, government reports, and a review of international sand-mining literature.

Source: IAI, 2006.

Table 1(b)

Data Collection Techniques Based on Required General Category of Information to Meet Main Objectives

OBJECTIVES 2 and 3	Provide a Comprehensive List of Detailed Mitigation Measures that can be Applied to Avoid Adverse Impacts to Fisheries that may be Present in OCS Sand Resource Areas in Collier County. Identify, Develop, and Evaluate Specific Proposals to Mitigate or Resolve Potential Spatial Conflicts Between the Commercial and Recreational Fishing Industries and the Development of OCS Sites as Long-term Sand Borrow Areas.
Location in Report	**Section 4**
General Category of Information Need	**Source and Research Methods**
List of possible mitigation measures.	Collection of data concerning mitigation measures from resident fishermen and from dredge company authorities; field observation; discussions with key government and industry individuals. Review and consideration of mitigation measures as identified in the literature review.
Mitigation measures that can be successfully implemented based on the values, belief systems and everyday practices of participants.	Analysis of data concerning mitigation measures from established list, field observation, and discussions with key industry and government persons.

Source: IAI, 2006.

Table 1(c)

Data Collection Techniques Based on Required General Category of Information to Meet Main Objectives

OBJECTIVE 4	Explore the Possibilities for Creating or Revising Institutional Linkages that might Facilitate Communication and Cooperation between the Various Fishing Components, MMS, and the Dredging Industry in the Future.
Location in Report	**Section 5**
General Category of Information Need	**Source and Research Methods**
Understanding of existing linkages.	Analysis of data concerning existing linkages; discussions with key officials to discern potential and suggested linkages.

Source: IAI, 2006.

1.3 Research Methods

1.3.1 Data Collection Techniques

Primary Source Data Collection. Much of the primary source data was obtained through interactions and discussions with fishing, industry and government representatives, and through observation while in the study communities. During initial field site visits, study teams engaged willing participants in informal, open-ended discussions, and were asked about their opinions on sand-mining operations. Participants included local and regional: (1) commercial and charter fishermen; (2) fishing-related infrastructure providers; (3) government officials; and, (4) dredge company workers and officials. Fishermen comprised the largest informant group. Researchers also attended meetings of the Cape Canaveral Charter Fishermen Association and the Collier County Coastal Advisory Committee where the local dredging projects were discussed.

Secondary Source Data Collection. Discussions with personnel at state and regional levels of government provided information on the regulatory environment of sand-mining in Collier County. Local community-level and county-level histories about the commercial and recreational fishing industries in their region, Census Bureau socio-economic data, and fishing-related commercial business listings from a private data source were also collected.

Time Frame. The findings in this report are based on one month of ethnographic research conducted in Brevard County in April 2005, one month of ethnographic research conducted in Collier and Lee Counties during May 2006, and two weeks of follow-up research conducted in Brevard County in June 2006.

Confidentiality. Efforts to protect the anonymity of respondents and the confidentiality of the information provided were enacted throughout the course of the project. Certain conversations are paraphrased in this report, but names are not provided and such information is presented only where respondents signed consent forms authorizing the judicious and confidential inclusion of their responses.

1.4 Principal Stakeholders

Identifying the stakeholders of the areas in which sand dredging for beach renourishment was occurring was critical to understanding the potential or real conflict that may subsequently result from such projects. Data collection strategies for this research relied upon both primary and secondary sources, and both "top-down" and "bottom-up" approaches were used to identify the various user-groups of the waters in question.

A "top-down" approach initially facilitated identification of user-groups in the early stages of this research. First, a NOAA-funded study on identifying communities associated with commercial fishing was used to establish a baseline from which study communities could be selected (IAI, 2005). Once a list of potential study communities was generated, we asked local fishery participants to identify both commercial and recreational user-groups of the waters directly offshore Port Canaveral, Canaveral Beach, Cocoa Beach, Naples Beach and Vanderbilt Beach, as these are also the sites of recent dredging operations. The user-groups and fishing areas identified by these participants further helped researchers determine the most appropriate location for a "case study".

A "bottom-up" approach was then applied to more precisely identify specific stakeholders. Fishery participants were approached at marinas, harbors, and ports within Brevard and Collier Counties to compile a list of potential participants working in the commercial and recreational fishing industries. A snowball or network sampling technique was subsequently used to identify respondents knowledgeable of factors and issues pertinent for purposes of description and assessment. Once rapport was developed with key informants, additional discussions were arranged and took place at their convenience. A review of the Brevard County and Collier County telephone directories aided in our attempt to generate the most inclusive list of fishing-related stakeholders and interest groups possible (see Blanchard *et al.*, 1999).

Data collection in Brevard County was concentrated in Port Canaveral, Titusville Municipal Marina, and Port Saint John Harbor (Figure 3). The principal user-groups in these areas are shrimpers, fin fishermen, charter captains and crew, recreational fishermen, and divers. In terms of numbers, commercial and charter fishermen from the Port Canaveral area who primarily fish the open waters surrounding the Canaveral Shoals comprise the two largest user-groups. Recreational fishermen comprise the third largest user-group. These fishermen are primarily weekend enthusiasts who live in nearby communities. Commercial and recreational fishermen who fish the inland Indian and Banana Rivers and their tributaries constitute additional user-groups. Due to the inland location of their fishing activities, these fishermen were the least affected by or concerned about offshore dredging activities.

Data collection in Collier County occurred in Everglades City, Chokoloskee, Isles of Capri, Marco Island, Goodland, Naples, Fort Myers, San Carlos, and Sanibel Island (Figure 4). The principal user-groups in the waters off of Collier County are crabbers and fin fishermen (Collier County), shrimpers (Lee County), and charter captains and crew, recreational fishermen, and ferry/pleasure tour boat operators. In terms of numbers, crabbers from the Goodland area south of Naples and shrimpers from San Carlos outside of Fort Myers comprise the largest user-groups. An estimated 100,000 crab traps are set in the waters off of Naples, up to 25 miles offshore. Because of the nature and intensity of this fishery, crabbers are very concerned about the impacts of dredging in their area. Shrimpers from Lee County, who must cross the dredge path to arrive at their fishing destination, are less concerned about the impacts of dredging as they (and charter fishermen) have been only indirectly affected by the recent dredge operation.

Conversations with a wide range of fishery participants in these areas helped define and contextualize the geospatial layout and boundaries of the key user-groups. For example, conversations revealed that commercial fishermen from Goodland in the south to Sanibel in the north tend to concentrate their fishing efforts in informally defined but commonly understood territories. Fishermen from Everglades City are predominantly crabbers, but primarily fish in the waters off their local coast. Crabbers from Goodland North fish almost exclusively in the near and offshore waters off of Naples. Additionally, the few fishermen on Sanibel Island target the Pine Island Sound and the areas immediately northward. In contrast, small recreational marinas are more dispersed, operating as far north as Ft. Myers.

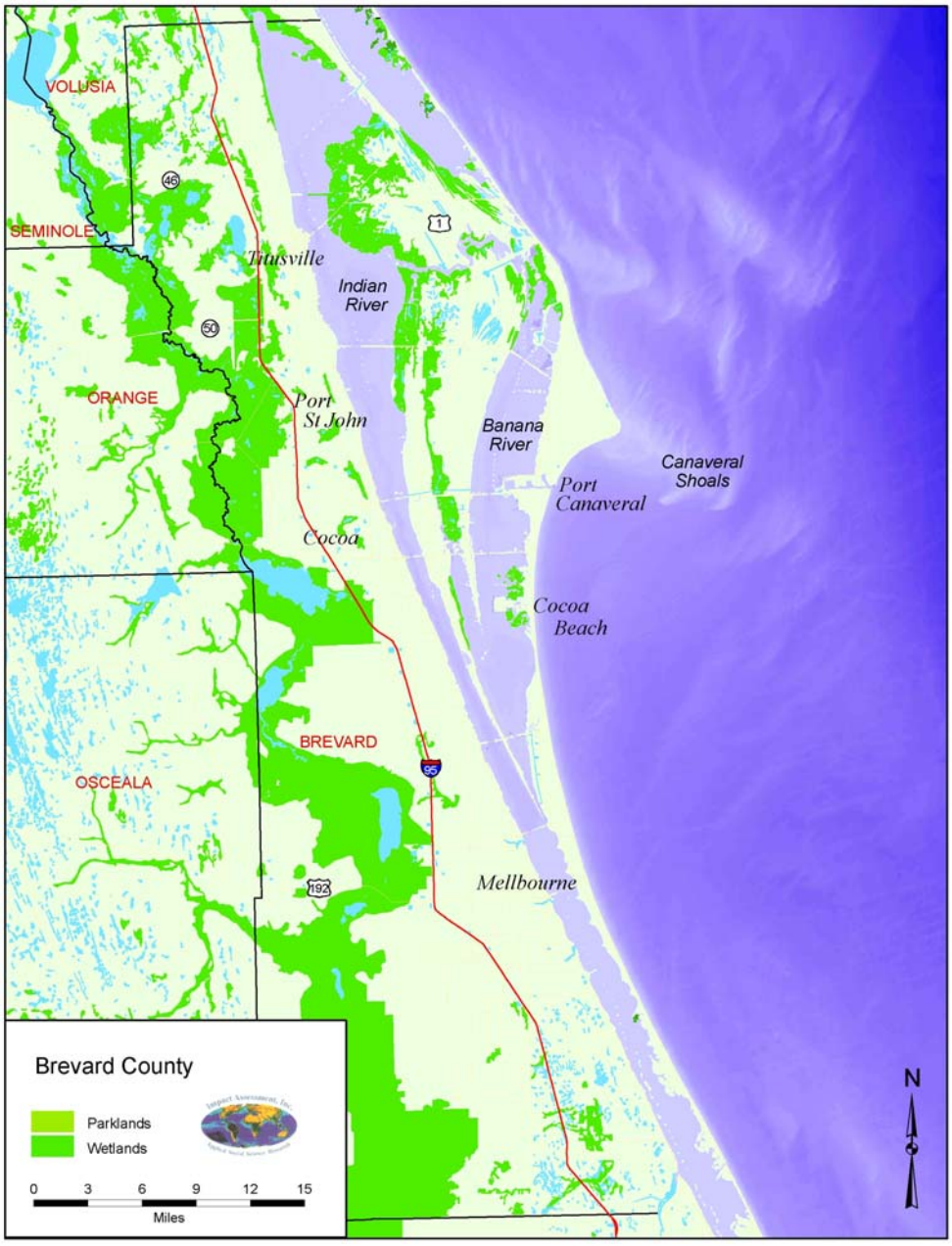


Figure 3. Brevard County Study Area (IAI, 2006).

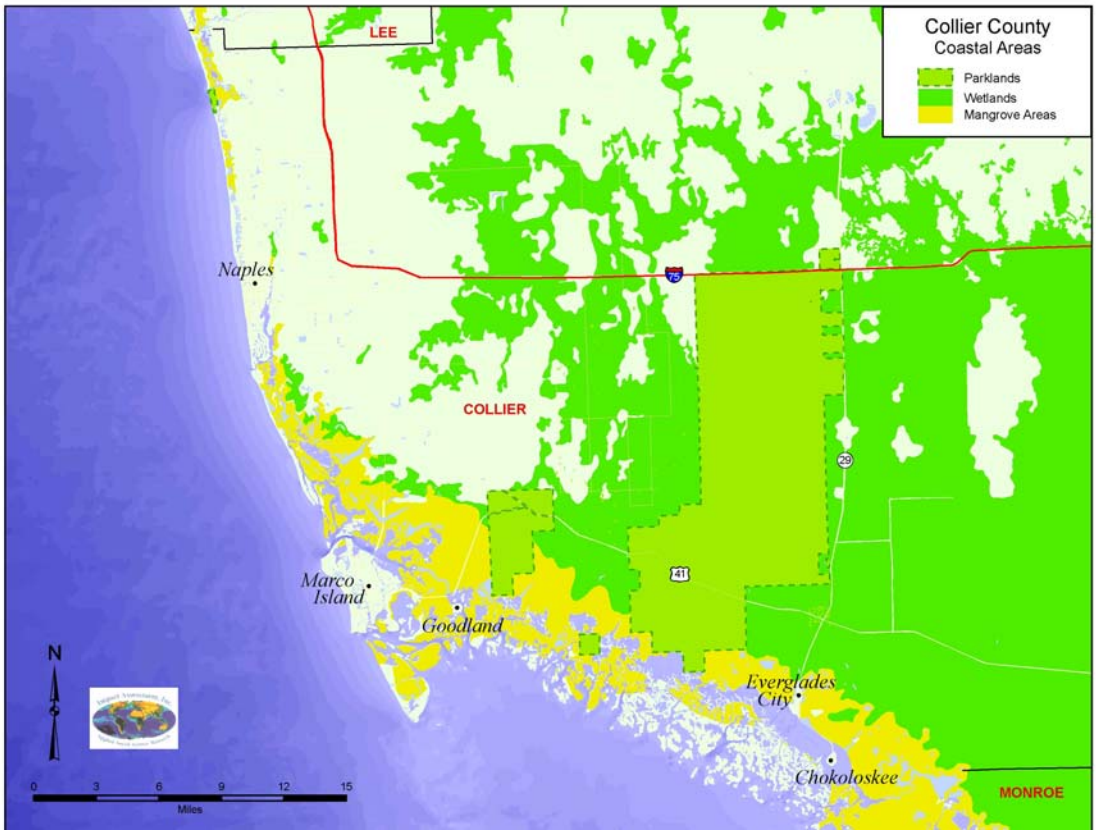


Figure 4. Collier County Study Area (IAI, 2006).

1.5 Participants

Approximately 121 persons discussed with us their opinions about the impacts of sand dredging in their marine community. Discussions were open-ended and informal; that is, no formal survey instrument was employed to guide these conversations. Participants included both direct users, such as commercial and charter fishermen, and indirect users, such as recreational fishermen. For this study we define "direct users" of the waterways as those individuals whose livelihoods depend on direct access to marine resources and, therefore, are the more likely to experience the impacts of sand dredging as economic. In contrast, "indirect users" do not primarily depend on access to marine resources for their livelihoods. This latter user-group may be inconvenienced by beach renourishment activities but are not likely to suffer economically as a result of such operations.

2.0 U.S. SURVEY OF DREDGING IMPACTS

2.1 Introduction

This section of the report first provides an overview of general sand dredging activities within U.S. waters (Table 2). It is followed by an overview of sand dredging along the Floridian coasts of Brevard and Collier Counties.

Table 2
U.S. Marine Sand Dredging – Key Facts

- The U.S. has a robust sand mining industry.
- Since 1923, a total of 1,744 renourishment projects have occurred in the U.S.
- Between 1923 and 2005, 20 coastal states have undergone renourishment, some multiple times.
- Since 1923, nearly 400 coastal areas have been dredged for storm and erosion control or to establish and/or maintain navigation routes.
- Of the total number of marine dredging projects conducted in the U.S. since 1923, the federal government has funded in total or in part 750 projects (43%) while state and local governments have funded 325 projects (19%); local, private, and unknown sources have funded the remainder.
- The majority of dredging projects for purposes of beach renourishment take place in fishing grounds and within the vicinity of major commercial fishing ports.

Source: Duke University, 2005.

2.2 An Overview of the U.S. Sand Dredging Industry

Navigational or maintenance dredging in the U.S. began in 1824 when the U.S. Congress tasked the U.S. Army Corps of Engineers (USACE) with dredging navigation routes along the Mississippi and Ohio Rivers (USACE, 2004, p. 1), a mission that marked the beginning of routine dredging of rivers and harbors in this nation.

The practice of beach renourishment in the U.S.–that is, taking sand from one marine location and using it to replace waterfront sand lost to erosion and other natural events –has a much shorter history than that of navigational dredging. The practice of beach renourishment was first initiated in response to shoreline erosion around 1923 when 1.7 million cubic yards of sand were distributed along 8,750 feet of shoreline on Coney Island in New York state. Since 1923, 20 U.S. coastal states have undergone between two and 90 beach nourishment/renourishment projects per year, on average (Duke University, 2005). According to USACE,

> Recent decades have seen an overall decline in budgets for civil works project construction, yet the range of objectives for water resources projects has broadened as society places more value on environmental and recreational benefits (2004, p. 1).

However, deepwater dredging did not become viable in the U.S. until the 1990s. At that time, sand-borrowing waters were extended from near shore state waters to include offshore federal waters.

According to MMS,

> MMS established state cooperatives and identified over 2 billion cubic yards of OCS sand resources and has conveyed more than 23 million cubic yards of sand for 17 shore protection projects to date. These projects have protected millions of dollars in infrastructure and thousands of acres of valuable wetland habitat (MMS, 2006b).

Florida has led the nation in beach renourishment projects, completing nearly 100 projects between 1923 and 2006. Florida also leads the nation in terms of the amount of sand it borrows from OCS sources. In 2005 the city of Jacksonville and Patrick Air Force Base, both in Brevard County, signed agreements with MMS to supply them with sand from OCS sources. Jacksonville's 1.5 million cubic yards, Brevard County's two million cubic yards, Patrick Air Force Base's 350,000 cubic yards, and Collier County's 673,000 cubic yards of federal sand represent important shifts in the regulatory process, as sand taken from federal waters necessitates MMS participation. The Collier County beach renourishment project– the focus of this study–is the fifth beach restoration agreement between the State of Florida and MMS (MMS, 2006b).

Spatial Distribution of Sand Mining Activities in U.S. Waters. Sand mining for renourishment purposes has experienced significant growth since its inception in 1923. According to Duke University, the Atlantic, Gulf of Mexico (GOM), and Pacific shores have undergone 1,744 renourishment projects between 1923 and 2005 (see Appendix I for individual state locations and maps). In the 20 coastal states that have engaged in sand-mining projects, a combined total of 400 beach locations have received sand for renourishment purposes., and most of those have been renourished multiple times. Virginia Beach, for example, has been renourished every year through 1996 since it was first nourished in 1951 (Duke University, 2005).

Historically, the eastern coast of the U.S. has been the recipient of the greatest amount of dredging activities. The west coast has also incurred a significant amount of dredging activity, with over 527 projects at 45 beaches in California occurring since 1927, and 13 projects at 11 beaches in Washington since 1994. Between 1939 and 2006 dredging and renourishment projects have also occurred along 31 beaches in New York; 7 in Maine; 2 in New Hampshire; 32 in Connecticut; 20 in Delaware; 70 in Massachusetts; 10 in Rhode Island; 54 in New Jersey; 2 in Maryland; 2 in Virginia; 17 in North Carolina; 14 in South Carolina; 2 in Georgia; 5 in Alabama; 6 in Mississippi; 7 in Louisiana; and approximately 30 in Texas. Florida is "the leader" in terms of number of dredge sites; 84 of its beaches and inlets have been targeted for renourishment and dredging projects (Duke University, 2005).

2.3 An Overview of the Current U.S Commercial and Recreational Fishing Industries

2.3.1 U.S. Commercial Fishing Industries

Though comparatively smaller than other industries, the U.S. commercial fishing industry contributes significantly to the national economy (Table 3). U.S. fish stocks additionally benefit regional and national economies through the support of the charter and recreational fishing industries, wholesale and retail fish markets and restaurants, and diving.

Table 3

U.S. Commercial Fishing Industry – Key Facts

- The U.S. supports a diverse and well-established commercial fishing industry.
- A wide range of species are harvested by the U.S. fleet, including finfish, invertebrates, and shrimp.
- There are 97 major commercial fishing ports located in 20 coastal U.S. states.
- In 2003, the value of processed fishery product was $7.5 billion; in 2004, it was $6.6 billion (NMFS, 2005b, p. 49).
- The majority of landings are made in Alaskan ports.
- In 2004, U.S. processing plants generated nearly 41 billion pounds, or 1.1 billion tons, of canned fishery product and 590 million pounds, or 268 million tons, of frozen product from domestic and foreign sources (NMFS, 2005b, p. 50).

According to the U.S. Bureau of Labor Statistics (USBLS), the fishing, hunting and trapping industry employed nearly 30,000 U.S. workers in 2004, representing 2.6 percent of the labor force. Roughly 17,000 or 57 percent of those employees worked solely in the fishing industry. This segment represents about 1.5 percent of the U.S. labor force (USBLS, 2006). Persons working in small fishing enterprises are generally self-employed.

Landings in the U.S. are recorded by the National Marine Fisheries Service (NMFS) branch of NOAA. Landings are classified by family as finfish, invertebrates, and shrimp. Finfish and shrimp are caught in state waters (roughly zero to three miles from shore) and in federal waters (roughly 3 to 200 miles from shore); invertebrates are harvested in the shallower state waters. However, fishing grounds can vary considerably between states, regions, and localities, depending on the target species. On the east coast of Florida, for example, Spanish mackerel is caught in Federal waters, while in Alabama they are found in state waters. And while most shark is harvested in the deeper waters of the Canaveral area off Florida's east coast, they are also caught in the shallower waters closer to shore (NMFS 2006).

According to NMFS, there are roughly 150 commercial fishing ports in the U.S., 97 of which are considered "major ports" by virtue of their consistently high landings in terms of value and poundage. Table 4 lists these ports in rank by pounds (weight) landed. In 2004, 10 billion pounds of seafood were landed at these 97 major U.S. ports, representing a combined value of $3.8 billion. Although the bulk of these landings occurred in Alaskan ports, significant amounts of fish were also landed in Virginia, Louisiana, Oregon, and California (NMFS, 2005a).

Table 4

Leading U.S. Ports by Pounds, 2004

Rank	Port	Millions of Pounds (lbs)	Millions of Dollars
1	Dutch Harbor-Unalaska, AK	886.8	167.4
2	Reedville, VA	400.5	26.1
3	Empire-Venice, LA	379.0	60.2
4	Kodiak, AK	317.4	94.0
5	Intracoastal City, LA	301.8	20.3
6	Cameron, LA	243.1	27.6
7	New Bedford, MA	175.1	206.5
8	Pascagoula-Moss Point, MS	162.8	11.9
9	Astoria, OR	135.8	19.9
10	Gloucester, MA	113.3	42.7
11	Newport, OR	111.2	29.6
12	Petersburg, AK	102.6	36.1
13	Cape May-Wildwood, NJ	97.5	68.1
14	Ketchikan, AK	96.7	25.8
15	Naknek-King Salmon, AK	92.6	42.5
16	Los Angeles, CA	92.1	16.3
17	Westport, WA	91.2	20.5
18	Port Hueneme-Oxnard-Ventura, CA	70.1	17.7
19	Beaufort-Morehead City, NC	63.5	16.9
20	Portland, ME	58.0	24.2
21	Moss Landing, CA	55.5	6.9
22	Cordova, AK	40.5	31.8
23	Dulac-Chauvin, LA	40.4	42.8
24	Point Judith, RI	39.6	31.5
25	Seward, AK	38.6	43.6
26	Sitka, AK	37.3	40.1
27	Hampton Roads Area, VA	34.5	100.6
28	Point Pleasant, NJ	33.4	19.2
29	Atlantic City, NJ	33.2	17.7
30	Wanchese-Stumpy Point, NC	31.4	20.6
31	Ilwaco-Chinook, WA	31.1	12.0
32	Rockland, ME	30.9	2.7
33	Coos Bay-Charleston, OR	29.8	25.2
34	Dillingham-Togiak, AK	28.2	13.3
35	Golden Meadow-Leeville, LA	26.1	31.6
36	Bellingham, WA	23.5	21.9
37	Kenai, AK	21.8	16.3
38	Eureka, CA	19.4	13.1
39	Port Arthur, TX	19.4	38.9
40	Bayou La Batre, AL	19.1	28.4
41	Honolulu, HI	18.9	45.8
42	Brownsville-Port Isabel, TX	18.7	40.3
43	Homer, AK	18.1	37.1
44	Morgan City-Berwick, LA	17.8	6.6
45	Crescent City, CA	17.0	20.1
46	Gulfport-Biloxi, MS	16.3	26.2
47	Galveston, TX	16.0	31.4
48	Key West, FL	16.0	43.2
49	Juneau, AK	15.0	19.8

Table 4

Leading U.S. Ports by Pounds, 2004 (con't).

Rank	Port	Millions of Pounds (lbs)	Millions of Dollars
50	Delcambre, LA	14.5	20.7
51	Provincetown-Chatham, MA	13.7	14.1
52	Palacios, TX	13.5	27.6
53	Grand Isle, LA	12.5	14.2
54	Tampa Bay-St. Petersburg, FL	12.3	21.6
55	Montauk., NY	12.1	13.0
56	Delacroix-Yscloskey, LA	12.0	14.4
57	San Francisco Area, CA	10.4	12.9
58	Shelton, WA	10.4	27.3
59	Stonington, ME	10.3	7.5
60	Fort Myers, FL	9.4	15.9
61	Engelhard-Swanquarter, NC	9.0	7.8
62	Boston, MA	8.8	8.8
63	Lafitte-Barataria, LA	8.8	10.9
64	Apalachicola, FL	8.6	5.2
65	Long Beach-Barnegat, NJ	8.6	20.6
66	Santa Barbara, CA	7.9	6.5
67	Seattle, WA	7.7	8.0
68	Wrangell, AK	7.7	8.5
69	Port St. Joe, FL	7.5	8.4
70	Bay Center-South Bend, WA	7.2	15.2
71	Mayport, FL	7.2	7.9
72	Blaine, WA	7.1	5.6
73	Oriental-Vandemere, NC	7.0	7.2
74	Hampton Bay-Shinnicock, NY	6.5	6.6
75	Fort Bragg, CA	6.4	7.2
76	Brookings, OR	6.2	8.6
77	Bon Secour-Gulf Shores, AL	6.0	7.0
78	Cape Canaveral, FL	6.0	9.3
79	Anacortes-La Conner, WA	5.4	6.1
80	Belhaven-Washington, NC	5.2	3.7
81	Charleston-Mt. Pleasant, SC	5.2	8.5
82	Neah Bay, WA	4.8	4.9
83	Monterey, CA	3.7	1.9
84	Tillamook, OR	3.7	3.8
85	Tacoma, WA	3.4	4.2
86	Darien-Bellville, GA	3.3	5.0
87	Yakutat, AK	3.2	3.3
88	Craig, AK	3.1	4.9
89	Port Orford, OR	3.0	4.8
90	Ft. Pierce-St. Lucie, FL	2.3	2.6
91	San Diego, CA	2.2	4.0
92	Port Angeles, WA	2.2	2.8
93	La Push, WA	2.1	3.7
94	Olympia, WA	2.0	6.3
95	Everett, WA	1.9	1.5
96	Port Townsend, WA	1.8	2.9
97	Anchorage, AK	1.1	0.6

Source: National Marine Fisheries, 2005a.

2.3.2 Spatial Distribution of Commercial Fishing Activity in U.S. Waters

Figure 5 depicts the location of the 97 leading U.S. ports in quantity of commercial fishery landings (heretofore referred to as a "major U.S. port"), and provides an indication of the source locations of commercial fishing traffic.

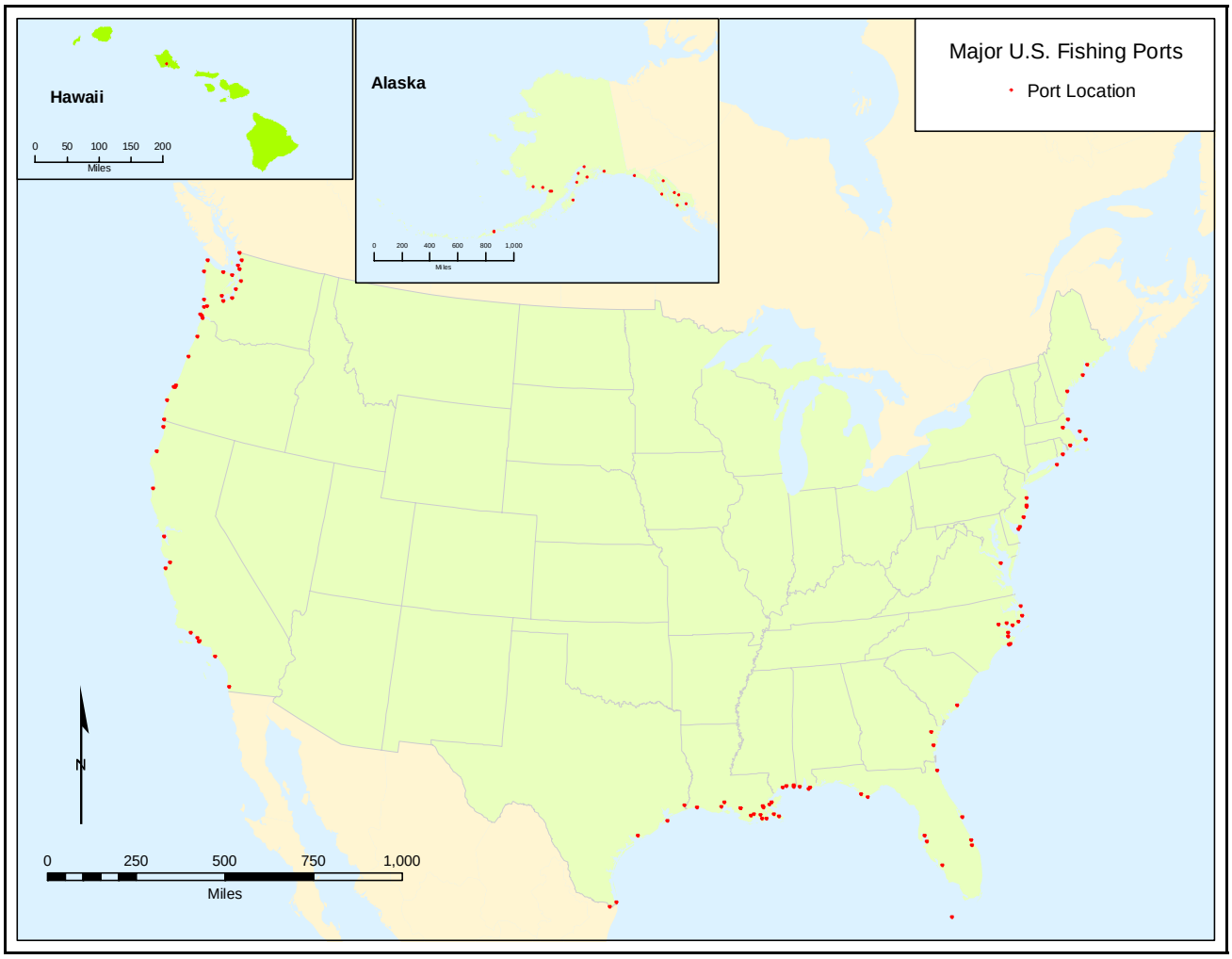


Figure 5. Major U.S. Ports (IAI, 2006).

2.3.3 U.S. Recreational Fishing Industries

Marine recreational angling is a major industry in the U.S. (Table 5). More than 14.4 million in-state residents and 8 million out-of-state anglers took a total of 81.6 million angler trips in 2004 (NMFS, 2005b). Recreational fishing provides over 1.3 million jobs nationwide and generates over 70 billion dollars in total economic output. Anglers spend approximately $24 billion directly on tackle, equipment, food and lodging, and other recreational fishing-related expenses each year in the U.S. Those expenditures generated over $2.1 billion in federal tax revenues (FWS, No date-c, p. 1).

Table 5

U.S. Recreational Fishing Industry – Key Facts

- Recreational angling is a major industry in the U.S.
- In 2004, about 14 million anglers made almost 82 million marine recreational fishing trips to the Atlantic, Gulf and Pacific coasts.
- The estimated total marine recreational catch in 2004 was 441 million fish.
- Nationally, 56 percent of the total recreational catch in 2004 came from inland waters, 32 percent from state territorial seas, and 12 percent came from the Exclusive Economic Zone (EEZ).

Source: NMFS, 2005b.

In terms of number of participants, the Atlantic coast is home to the largest concentration of recreational anglers, with 6.4 million in-state residents taking 48 million trips in 2004 (Table 6). In that year, Atlantic Coast residents caught 229 million fish. Twenty-two percent of trips were made in East Florida. The most commonly caught non-bait fish (in numbers of fish) were: Atlantic croaker, summer flounder, striped bass, bluefish, and spot.

Table 6

U.S. Participation in Marine Recreational Angling: 2004

Region	# of In-state Anglers (in millions)	# of Trips (in millions)	Fish Caught (in millions)	% Caught in State Territorial Seas	% Caught in Inland Waters	% Caught in EEZ
Atlantic	6.4	48.0	229.0	30	57	13
Pacific	4.0	4.8	18.0	82	10	8
GOM *	3.6	24.0	187.0	28	61	11
Hawaii	0.4	2.9	4.5	NA	NA	NA
Total	14.4	79.7	438.5	32	56	12

* Gulf of Mexico (excludes Texas)
Source: NMFS, 2005b.

2.3.4 Impacts of Sand Dredging on U.S. Fish Resources and Fisheries

Impacts on Fish Resources. Given the overlap in space usage between the sand mining industry and the fishing industry in the U.S., and given the concern with sustaining U.S. fish stocks, there is increased impetus to examine impacts associated with dredging. The U.S. fisheries are governed by regional management councils, authorized to manage fisheries through fishery management plans. Such plans describe the documents providing the rules that govern a fishery. They are fundamental to informing regional federal regulations for fisheries, and providing guidance for understanding impacts on fisheries (see ICES, 1992). The key issues most frequently associated with sand mining as it relates to fish resources are listed below in Table 7 and include:

(**1**) ***Seabed disturbance***. Seabed disturbances are the most frequently cited concern associated with dredging operations. With regard to seabed disturbance, related impacts include effects to spawning grounds and removal of benthic forage species (National Research Council, 2002, pp. 48-56; ICES, 1992; Currie and Parry, 1996; Van Dolah, et al., 1996; Thrush, et al., 1995). A reduction in spawning may occur on occasions where spawning periods and dredging overlap, thereby decreasing a particular species in a localized area. Anchor dredging tends to produce severe but localized effects whereas suction dredging over larger areas produces less severe but more widespread effects.

(2) ***Creation of sediment plumes.*** Sediment plumes affect fish physiology by blocking their gills, leaving fish less able to efficiently hunt and avoid prey. Larvae and post-juvenile fish are more susceptible. MMS identified three principle factors that contribute to the creation of sediment plumes: (1) the technique used for dredging; (2) the characteristics of sediment, which determine the extent to which bed material is disturbed and remain in suspension; and (3) condition of overlying waters, including water depth, current velocity and shear, turbulence, temperature, wave climate, and salinity (Hitchcock and Bell, 2004; Stone, 2000).

(3) ***Noise emissions.*** Attention has also been paid to noise emissions associated with marine aggregate dredging. Two primary impacts of noise emissions on fish resources include loss of hearing and disruption in migration. In their study of dredging in the North Sea, for example, the Maritime Regional Advisory Process found that fish migrations to access spawning areas were altered during dredge activity (Maritime Regional Advisory Process, 1997:3).

(4) ***Chemical effects.*** ICES (1992) notes that the majority of marine aggregates used for beach nourishment are composed of large particles of matter that have a low surface area relative to total size, and low surface activity. These characteristics thus interrupt chemical interaction with the water column. Further, such aggregates tend to be less inundated with debris or non-aggregate particulate matter than particles extracted from inshore estuarine or deeper channels where finer sediment is found. While minimal, chemical impacts are still present. Extraction processes determine the extent to which chemicals are released. These include: (1) types of dredges; (2) disposal of "wastes" over side; (3) depth of water in which sediments are extracted and depth of sediments; (4) types of sediments; and (5) benthic community structure and type of indigenous species in area.

Table 7

Summary of Primary and Secondary Effects of Dredging on U.S. Fish Resources

Primary Impacts on Fish Resources from Dredging	Secondary Impacts
Seabed disturbance	Removal or disruption of benthic communities upon which species rely for food. Disruption of spawning areas.
Creation of sediment plumes	Blanketing of benthic communities; blanketing of spawning areas.
Noise emissions	Hamper fish migration; create loss of hearing.
Chemical effects	Pollution of habitat; unknown species impact.

Source: IAI, 2006.

Key Impacts on U.S. Fisheries. According to Simpson (2004), the four most commonly named impacts of sand-mining operations on the fishing industry include gear loss, increased boat traffic, restricted access to traditional navigation routes, and limited access to traditional fishing grounds.

(1) Loss of gear. The loss of gear due to dredge operations is the single most contentious impact voiced by fishermen. Crab and lobster fishermen, in particular, allegedly lose many traps during dredging operations. In the waters off of the northeast coast, for example, the movement of dredge equipment has been associated with the wholesale loss of lobster traps. In other cases, traps are lost when the buoy lines holding the traps in place are severed, thus interfering with equipment retrieval. Torn and damaged nets from passing dredging vessels and rocks churned up during dredging activities are also cited in the literature as a problem for some fishermen (Ahmad 2003). The costs of replacing lost gear and the loss of income from lost catch can severely affect one's livelihood.

(2) Increased boat traffic. The increased amount of boat traffic that occurs during dredge operations also increases the potential for collision. Although the potential for collision is always present in heavily traveled waters, this potential increases with the introduction of dredging vessels because moorings are often relocated. This potential can be mitigated through standard navigational procedures, officially regulated by the U.S. Coast Guard, and through increased communication efforts.

(3) Restricted access to traditional navigation routes. Fishermen also indicate that they are sometimes inconvenienced when they lose access to their traditional navigation routes during dredge operations. Such inconveniences can cost fishermen time and money, including increased fuel costs.

(4) Limited access to traditional fishing grounds. Marine sand-mining operations can restrict the access of commercial fishermen to their customary fishing grounds. The conflict that may result from such restrictions can be averted in cases where dredging is short term and/or conducted off-season.

2.4 The Regulatory Environment for Sand Dredging in the U. S.

2.4.1 Overview

The decision-making process that surrounds an initiative to provide beach restoration or renourishment begins locally at the county or city level, and may take years from inception to installation (Marine Board, 1995, p. 27). Many beachfront counties, such as Collier and Brevard Counties in Florida, have a designated coastal management task force through which decisions concerning shoreline erosion are made. Brevard County's coastal decisions are handled through its Natural Resources Management Office; the Coastal Advisory Committee oversees coastal concerns in Collier County.

Brevard County. The Brevard County Natural Resources Management Office (NRMO) is comprised of three complementary and coordinating departments: Environmental Management, Environmental Planning, and Environmental Remediation Compliance. The Environmental Management department is central to the planning stages of a renourishment project. It is responsible for preparing "innovative, comprehensive and scientifically-based environmental management plans that ensure the long-term conservation of Brevard's natural communities while fostering local economic development, tourism and recreation opportunities for Brevard's citizens and visitors" (Brevard County, 2005a). Permitting occurs after a management plan is established through the NRMO's Environmental Planning section. Standards for permitting include sensitivity to wetlands, floodplains, aquifer, recharge areas, surface waters, coastal areas, and other critical habitat. Finally, the Environmental Remediation and Compliance department is responsible for managing the County's ground and drinking waters and for the disposal of hazardous waste.

The NRMO has a dozen programs through which planning, permitting, and action compliance take place, including Beach and Dune Restoration. Once the process is completed by NRMO, natural resources information established through the programs is then submitted to the Board of County Commissioners (Brevard County, 2005b).

Collier County. The Collier County Coastal Advisory Committee is the acting county-level agency responsible for initiating and overseeing coastal management projects, including shoreline renourishment, in Collier County. This Committee, formed in 2003, was formerly the Renourishment and Maintenance Committee of 1991, which was Collier's County's first coastal management organization. This Committee, though not as developed as Brevard County's NRMO, must adhere to the same restrictions and regulations set by state and federal agencies. Although this body operates on a volunteer basis and is not a decision-making body its recommendations wield significant influence. Primary functions of this committee include: initiating survey work and consultation with a coastal research agency to better understand ocean floor topography, identifying potential borrow sites and sensitive marine areas, and making sure that specifications set by the Florida Department of Environmental Protection (FDEP) with regard to placing sand on state coastlines are met. The county and city are responsible for setting bids for contract work, managing awarded contracts, and providing public notification about projects in local newspapers under the direction of FDEP.

With regard to state agency involvement, each state has a coastal zone management plan and an agency that enacts the plan. In the state of Florida, the FDEP is the primary state agency responsible for beach management and nourishment/renourishment decision-making. The Beach Management Program (BMP) of the FDEP oversees the protection, preservation, and restoration of state coastal beaches that front the Atlantic Ocean, the Gulf of Mexico (GOM), and the Straits of Florida. It is through this FDEP program that eligible governmental agencies must apply for permits to engage in nourishment projects. Under Section 62B-36 of the FDEP Beach Erosion Control Assistance Program, governmental entities may apply for co-sharing of costs associated with nourishment projects. Local government agencies, along with relevant state and federal agencies, such as the FDEP (state) and the Army Corps of Engineers (federal), define the project, including project boundaries, shoreline configuration, and placement of sand (Marine Board, 1995, p. 32).

Five agencies of the federal government participate in coastal management, coastal hazard reduction, and beach nourishment/renourishment: (1) the U.S. Army Corps of Engineers (USACE); (2) the National Oceanic and Atmospheric Administration (NOAA); (3) the Federal Emergency Management Agency (FEMA); (4) the U.S. Geological Survey (USGS); and, (5) the Minerals Management Service (MMS). The mission statement and jurisdiction of each agency determines, to a large extent, its role in beach renourishment (Table 8).

Table 8

Federal Agencies with Involvement in U.S. Beach Nourishment

Federal Agency	Scope of Role in Beach Protection	Related Legislative Acts and Year of Establishment
USACE	To manage the nation's waterways and wetlands and to protect coastal areas from hurricane and coastal storm damage; to construct projects approved by Congress for flood control, commercial navigation, or shipping channel maintenance; to provide emergency response to natural disasters; to operate and maintain flood control reservoirs and public reclamation facilities; to regulate activities in wetlands including issuing dredge and fill permits, and to authorize the establishment of wetland areas.	Public Law 71-520 (1930)
NOAA	To administer the CZMA through a partnership with 24 coastal states and five island territories; to participate on mitigation teams, information sharing, and funding.	Coastal Zone Management Act (1972)
FEMA	To coordinate post-disaster planning and response activities	The Congressional Act of 1803
USGS	To investigate, collect, analyze, monitor, and disseminate critical information about the nation's energy, mineral, water, and land resources.	43 U.S.C. 31 (1879)
MMS	To administer minerals (including sand and gravel) found in federal waters; to lease, develop, explore, produce, and manage royalties of OCS resources; mitigates potential environmental impacts caused by resource extraction	Outer Continental Shelf Lands Act 103-426 (1953)

Source: Marine Board, 1995, pp. 58-70.

U.S. Corps of Army Engineers (USACE). The USACE Public Law 71-520 was created by Congress in 1930 in response to a request by the State of New Jersey for federal assistance in beach erosion control. At this time, Congress designated USACE to protect the U.S. coastline from long-term effects of flooding and erosion. Its role in beach nourishment is an extension of its work in civilian projects (Marine Board, 1995, p. 58).

The USACE's overarching mission is to manage the nation's waterways and wetlands, and to protect coastal areas from hurricane and coastal storm damage. According to the USACE, other responsibilities include:

> Constructing projects approved by Congress for flood control, commercial navigation, or shipping channel maintenance; emergency response to natural disasters; operating and maintaining flood control reservoirs and public reclamation facilities; and regulating activities in wetlands including issuing dredge and fill permits and authorizing the establishment of wetland areas (2006).

Regarding shore protection, the USACE, under the authorization and funding of Congress, becomes involved when communities request assistance and the potential project is on publicly accessible beaches. Further, a number of studies must be performed to determine a positive cost/benefit ratio. According to USACE, "Although Corps projects provide benefits such as shoreline protection, habitat protection and renewal, and the generation of tax dollars associated with that recreation, the primary purpose is always the protection of life and property" (2006, p. 1). The Corps then selects from various shore protection options, including jetties, seawalls, and beach renourishment. Together with MMS, other federal, state, and local government agencies, and private dredging companies, USACE is charged with managing offshore dredging and beach nourishment projects.

National Oceanic and Atmospheric Administration (NOAA): NOAA, under the Department of Commerce, administers the Coastal Zone Management Act (CZMA). Established in 1972, the program created by this act facilitates cooperation between state and federal government agencies so that they may actively manage coastal resources. NOAA has approved coastal management programs for 24 coastal states and five island territories. NOAA's actions are limited, however, in that they must work through approved state agencies (Marine Board, 1995, p. 62). According to the Marine Board,

> The CZMA declares a national policy for minimizing the loss of life and property caused by inappropriate development in areas prone to erosion and coastal flooding. NOAA seeks to achieve this goal through state coastal management programs, and has placed increasing emphasis on improvement in this area through the Coastal Zone Enhancement Program. NOAA assists states with technical assistance in the areas of coastal hazards through various activities, including participation on mitigation teams, information sharing, and, in limited cases, by using discretionary funding to conduct post-storm research for use in coastal hazard planning efforts (Marine Board, 1995, p. 61).

The Federal Emergency Management Agency (FEMA): FEMA is responsible for (1) mitigation, (2) preparedness, training, and exercise, (3) response and recovery, and (4) operations support of post-disaster situations, which may include flooding. It manages the National Flood Insurance Program, which is a financial protection and hazard mitigation program, providing benefits to residents living in coastal floodplains. Nourishment projects can be considered for benefits through FEMA (Marine Board, 1995, p. 64).

The U.S. Geological Survey (USGS): USGS is the primary science agency of the Department of the Interior. Established in 1879 by legislative act 43 U.S.C. 31, its mission is to investigate, collect, analyze, monitor, and disseminate critical information about the nation's energy, mineral, water, and land resources. USGS also oversees the National Marine and Coastal Geology Program. This program conducts studies in four areas: (1) environmental quality and preservation; (2) natural hazards and public safety; (3) natural resources; and (4) information technology (Marine Board, 1995, p. 69).

Minerals Management Service (MMS): MMS is a bureau of the U.S. Department of the Interior. The MMS was established by the Outer Continental Shelf Lands Act in 1953. This agency only has jurisdiction over offshore non-renewable (oil and gas) and renewable (wind, wave, and solar) energy, and coastal restoration (sand and gravel) resources in the federal waters of the OCS. Coastal restoration projects are managed by MMS's Marine Minerals Program (MMP). This program provides policy direction for the development of marine mineral resources on the OCS. The MMP has partnerships with 14 coastal states, including Florida, that work toward the collection and analyzing of geologic and environmental information of OCS sand deposits that may be suitable for beach nourishment and wetlands protection projects (MMS, 2006b).

The policies and programs enacted by the five federal agencies described above are far reaching in their scope relating to resource management (including research and monitoring), personal real property protection, and financing of management programs.

Throughout the years, a number of committees have been established to oversee the management of beach nourishment. Through discussions with the U.S. Army Corps of Engineers, for example, and in cooperation with MMS, the Marine Board of the National Research Council's (NRC) Commission on Engineering and Technical Systems determined that,

> [A]n improved technical basis for decision making could be established by exploring the engineering, environmental, economic, and public policy aspects of beach nourishment. Important factors meriting assessment include improvements in the understanding of shore processes; definition of the appropriate role of beach nourishment in shore management; and enhancements and improvements in predictive capabilities, project monitoring, and performance evaluation (Marine Board, 1995).

As a result of their study, the NRC convened the Committee on Beach Nourishment and Protection under the auspices of the Marine Board (Marine Board, 1995).

Along with the establishment of multiple government agencies to address coastal renourishment issues, a wide range of federal, state, and local laws and regulations have been enacted to further regulate U.S. coastal renourishment projects. Table 9 depicts these laws.

Table 9

Laws Relating to Beach Renourishment

Law	Year	Provisions	Relevance
River and Harbor Act, P.L. 71-520	1930	Authorized USACE to conduct shoreline erosion control studies (not construction) in cooperation with state governments; the Beach Erosion Board (BEB) was also established.	First federal involvement in shoreline protection activities.
Shores of Publicly Owned Property Act, P.L. 79-727	1946	Expanded the use of federal funds to include one third of construction costs in addition to the studies for projects along publicly owned shores.	Expanded federal involvement as a result of major hurricanes.
Submerged Lands Act (43 USC 1301 and following)	1953	Gave coastal states authority over the resources of submerged lands from the shore out to three miles seaward.	Affected the availability of offshore sand for beach nourishment.

Table 9

Laws Relating to Beach Renourishment (con't).

Law	Year	Provisions	Relevance
Outer Continental Shelf Lands Act P.L. 95-372 (43 USC 1331 and following)	1953	Provided for the federal government to manage the mineral resources of the OCS lying on or under the seabed that extends seaward from state waters out to the edge of the shelf.	Affected the availability of offshore sand for beach nourishment.
Shores Construction Against Erosion Act, P.L. 84-826	1956	Expanded the authority for federal shore protection to include privately owned shores where substantial public benefits would result; also defined periodic renourishment as construction that would provide a ten-year period of shore protection.	Federal authority now included shore protection on privately owned shores where public benefits result.
River and Harbor Act (33 USC 401 and following); (P.L. 87-874); (P.L. 980-483)	1962; 1968	Under Section 103 (33 USC 426g), the Corps was authorized to participate in the cost of protecting the shores of publicly owned property and private property where public benefits result; increased federal aid from one third to 100 percent for shore protection study costs leading to authorization; also increased federal participation in the cost of beach erosion and shore protection to 50 percent of the construction cost when the beaches were publicly owned or used, and 70 percent for seashore parks and conservation areas when certain conditions of ownership and use of the beaches were met. Under Section 111 (33 USC 426i), mitigation could be conducted for shoreline erosion that results from federal navigation works.	Resulted in a large number of studies and subsequent authorizations in the 1950s and 60s; Required USACE to fund mitigation for downdrift erosion caused by federal navigation works.
Coastal Engineering Research Act, P.L. 88-172	1963	Established the Coastal Engineering Research Board (CERB) and the Coastal Engineering Research Center (CERC), replacing the Beach Erosion Board.	Resulted from increased need for additional engineering and study in the area of beach erosion, coupled with increased beach development and more demand for erosion relief from the federal government.
National Historic Preservation Act (16 USC 470 and following)	1966	Federal agencies must consider the effects of their undertakings (including the issuance of permits, the expenditure of federal funding, and the initiation of federal projects) on historic resources that are either eligible for listing or are listed on the National Register of Historic Places.	Areas worthy of historic preservation must be avoided in the beach nourishment site selection process.

Table 9

Laws Relating to Beach Renourishment (con't).

Law	Year	Provisions	Relevance
National Environmental Policy Act (42 USC 4321 and following)	1969	Required federal agencies to evaluate the environmental impacts associated with major actions they fund, support, permit, or implement.	Required that actions be the least environmentally damaging practicable alternative. Most beach nourishment projects have the potential for adverse impacts and will trigger a required NEPA analysis.
Coastal Zone Management Act (16 USC 1451 and following) (P.L. 92-583)	1972	Required all federal agencies with activities directly affecting the coastal zone, or with development projects within the zone, to assure that those activities or projects are consistent with the approved state Coastal Zone Management Program.	Established a national program to assist the states in comprehensively managing the nation's coastal resources through wise management practices. Encouraged coastal zone management and provided grants (Section 306A) for maintaining coastal areas.
Clean Water Act (33 USC 1251 and following)	1972; 1977	Under section 404, a permit was required for the discharge of dredged or fill materials into the waters of the U.S. The USACE has the permitting authority for the 404 program.	Proponents of beach nourishment projects must obtain a Section 404 permit.
Endangered Species Act (16 USC 1531 and following)	1973	Federal agencies must review actions they undertake or support to determine whether they may affect endangered species or their habitats; agency must consult with the USFWS.	Significant impacts on beach nourishment projects; limitations on construction typically exclude construction in certain seasons, e.g., the nesting season for sea turtles on the Atlantic and Gulf Coasts. There are short-term environmental impacts associated with both removing the sand from the source and depositing it onto the beach.
Water Resources Development Act (33 USC 2201 and following): (P.L. 94-587); (P.L. 99-662); (P.L. 100-676); (P.L. 102-580); (P.L. 104-303); (P.L. 106-53); (P.L. 106-541).	1976; 1986; 1988; 1995; 1996; 1999; 2000	Established a broad congressional policy to encourage conservation efforts among federal, state, and local governments. Authorized the Secretary of the Army to construct, operate, and maintain any water resource development project. The resource development projects over which the USACE currently maintains jurisdiction are navigation, flood control, shore protection, and beach renourishment projects.	Authorized beach nourishment projects. Set cost-sharing percentage, with a general trend to reduce federal percentage and increase non-federal percentage (will be 50/50 by 2003).
Coastal Barrier Resources Act (16 USC 3501 and following), (P.L. 97-384)	1982	Established the Coastal Barrier Resources System (CBRS); areas in the CBRS may no longer receive federal financial assistance for new construction or improvements. The CBRS was greatly expanded with the passage of the Coastal Barrier Improvement Act (CBIA) of 1990 (P.L. 101-591).	The intent of the law was to discourage development in sensitive coastal barrier environments to protect human life, conserve federal financial resources, and help conserve important wildlife habitats. The law applied only to areas within the defined CBRS.

Law	Year	Provisions	Relevance
National Environmental Policy Act (42 USC 4321 and following)	1969	Required federal agencies to evaluate the environmental impacts associated with major actions they fund, support, permit, or implement.	Required that actions be the least environmentally damaging practicable alternative. Most beach nourishment projects have the potential for adverse impacts and will trigger a required NEPA analysis.
Coastal Zone Management Act (16 USC 1451 and following) (P.L. 92-583)	1972	Required all federal agencies with activities directly affecting the coastal zone, or with development projects within the zone, to assure that those activities or projects are consistent with the approved state Coastal Zone Management Program.	Established a national program to assist the states in comprehensively managing the nation's coastal resources through wise management practices. Encouraged coastal zone management and provided grants (Section 306A) for maintaining coastal areas.
Clean Water Act (33 USC 1251 and following)	1972; 1977	Under section 404, a permit was required for the discharge of dredged or fill materials into the waters of the U.S. The USACE has the permitting authority for the 404 program.	Proponents of beach nourishment projects must obtain a Section 404 permit.
Endangered Species Act (16 USC 1531 and following)	1973	Federal agencies must review actions they undertake or support to determine whether they may affect endangered species or their habitats; agency must consult with the USFWS.	Significant impacts on beach nourishment projects; limitations on construction typically exclude construction in certain seasons, e.g., the nesting season for sea turtles on the Atlantic and Gulf Coasts. There are short-term environmental impacts associated with both removing the sand from the source and depositing it onto the beach.
P.L. 103-426	1994	As amended by the Outer Continental Shelf Lands Act, this public law provides the Secretary of the Interior with new authority to negotiate agreements for use of federal sand, gravel or shell resources under certain circumstances.	Prior to Public Law 103-426, enacted October 1994, hard mineral resources could only be obtained through a competitive lease sale process stipulated under the OCS Lands Act. P.L. 103-426 allows MMS to undertake noncompetitive leases for public works projects.
Shore Protection Act (Section 227 of the WRDA; 33 USC 2601).	1996	Recommended funding for shore protection project studies and construction.	Rejected the Administration's position of not authorizing funding for new projects.

Source: NOAA, 2002.

All of the laws and regulations listed above either pertain to the potential impacts that beach renourishment projects can have on the environment, including endangering species or critical habitats, or to funding constraints for such projects. The National Environmental Policy Act (NEPA) is one such keystone piece of legislation.

The National Environmental Policy Act (NEPA). NEPA was established with purposes of broad-ranging environmental protection. Through this act, federal agencies and their decision-makers abide by "action-forcing" procedures that account for and analyze the potential impact of proposed projects on the environment (Drucker et al., 2003, p. 17). Federal agencies must prepare an Environmental Impact Statement (EIS) as mandated by 40 DFR 1502, and file it with the EPA under 1506.9. According to the EPA,

> The National Environmental Policy Act requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. To meet this requirement, federal agencies prepare a detailed statement known as an Environmental Impact Statement (EIS). NEPA reviews and comments on Environmental Impact Statements prepared by other federal agencies, maintains a national filing system for all Environmental Impact Statements, and assures that its own actions comply with NEPA (2006).

The protocol for an analysis is provided by the Council on Environmental Quality. An impact may be ecological, aesthetic, historic, cultural, economic, social, or health-related; it also may be direct, indirect, or cumulative (Drucker *et al.*, 2003:17). Such impacts on the human environment are critical. Under 40 CFR 1508.14, the regulatory definition of the "human environment" is as follows:

> Human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment. (See the definition of "effects" [Sec. 1508.8]). This means that economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment (NEPA Section 1508, 1969, p. 14).

According to this definition and regulation, no EIS is required to study economic and social effects when these occur in isolation. However, when they are interrelated to the natural or physical environment, then related effects must be considered.

2.4.2 The Role of the Minerals Management Service (MMS)

The 1953 Submerged Lands Act authorized state jurisdiction over offshore lands within three nautical miles of shore for most states, and three marine leagues (nine nautical miles) for Texas and the Gulf Coast of Florida. It additionally afforded the federal government jurisdiction over the OCS, and determined the regulatory environment for uses of marine aggregates by a county or a city. In agreement with this act, any lessee, or body seeking to lease an area of water under state or federal government jurisdiction for the purposes of sand, gravel, or mineral extraction, must negotiate terms of a lease with either a central branch of the state or federal government. As MMS oversees sand, gravel, and/or mineral extraction activities in federal waters, a lessee wishing to extract from federal waters must negotiate a lease with this branch of the federal government. Section 8 (k)(2)(A)(i) of the Outer Continental Shelf Lands Act (43 U.S.C. 1331 et seq.), specifies the conditions of leases in federal waters for the purposes of sand, gravel, or mineral extraction.

Two mandates, the Outer Continental Shelf Lands Act Amendment of 1978 (OCSLA) and the National Environmental Policy Act (NEPA), bind MMS to providing necessary information for balanced decision-making. Such information requires that MMS study the marine, coastal, and human environments. Under Title 43, Chapter 29, Subchapter III (Sections 1331 and 1346) "minerals" is defined as *all* minerals (not limited to oil and gas) on submerged federal lands and requires a study of environmental impacts on human, marine, and coastal environments.

Federal Application Stages and the MMS Lease Process for Offshore Borrow Sites. Beach renourishment is only one of many options considered in response to coastal erosion. The decision to renourish depends in part on engineering and economic analyses, and on cost (Marine Board, 1995, pp. 27-28). According to the Marine Board,

> An important but often inadequately addressed component of beach nourishment programs involves the inclusion of diverse interested and affected parties to ensure that their concerns are accommodated. This inclusion is necessary in order for these parties to accept "ownership" in project goals and objectives (1995, p. 258).

The application stage of an MMS lease for an offshore borrow site begins with a request from an authority in need of the resource. Next, a memorandum of agreement with the Secretary of Interior listing the proposed uses of resources is issued. Leases are then granted through competitive bidding or noncompetitive leasing processes (Marine Board, 1995, p. 71).

In the case of a MMS competitive lease, a lessee submits a written request specifying the area to be nourished and justification for the lease to MMS. MMS then decides whether or not it will permit a lease. In the event that a lease is permitted, MMS sends a Request for Information and Interest (RFII), which consists of an Environmental Impact Statement (EIS). This NEPA requirement details any impacts the project may have on the coastal, marine, or human environment. Once the RFII/EIS is completed, submitted to, and reviewed by MMS, a Notice of Intent is made public; a public comment period follows. After the comment period expires, MMS ensures that the lessee has a coastal management plan consistent with the Coastal Zone Management Act. In the State of Florida, for instance, the coastal management plan is undertaken by the Florida Department of Environmental Protection. Once compliance is established, a Proposed Leasing Notice (PLN) is released, and is again followed by a public comment period. The Final Leasing Notice (FLN) must be submitted 30 days prior to lease sale. Whether the lease is accepted or rejected determines the next set of requirements for the process.

Several time factors can slow the process. In the case of a MMS competitive lease, a period of 45 days is allowed to lapse between the time of request submission and the initial response before MMS decides if it will permit a lease. After the RFII is made, 60 to 90 days are allowed to lapse before the environmental impact statement must be submitted. The Notice of Intent and Comment period requires 30 days, while 90 days are allowed for MMS to confirm if a state's coastal zone management plan is in compliance with the CZMA. Following the release of the Proposed Leasing Notice (PLN), 60 days are allowed for a public comment period. Although the review of the PLN comments and preparation of lease documents entails an undetermined time period, the Final Leasing Notice (FLN) must be submitted 30 days prior to lease sale. Whether the lease is accepted or rejected determines the next round of time-sensitive processes. In whole, approximately one year is required for the completion of a competitive lease sale (see Table 10 below).

Table 10

Time Frame for Competitive Leasing

Action	Time Required (days)
Submission of request to initial response and RFII	45
RFII to EIS	60-90
Notice of Intent and Comment Period	30
Request for notice of consistency with state's coastal zone management plan to response	90
Proposed Leasing Notice and Comment Period	60
Review of PLN comments, preparation of lease sale document	Undetermined
Final Leasing Notice	30
Sale of lease, review of sealed bids for fair market value, acceptance or rejection of lease	Undetermined

Source: MMS, 2006a.

In non-competitive leasing, no public comment period is required for a project plan and, as such, the process is simplified. NEPA does require, however, that MMS provide an Environmental Assessment (EA) or Environmental Impact Statement (EIS) describing potential impacts of OCS sand extraction on coastal, marine, and human environments. With regard to the preservation of fisheries, both EIS and EA require 1) an Essential Fisheries Habitat and 2) and Endangered Species Act Assessment and Consultation.

Impacts on Essential Fisheries Habitat are to be addressed by the Federal agency requesting the EA or EIA, beginning with notification to NOAA Fisheries of undertaking an Essential Fisheries Habitat (EFH) consultation, followed by an EFH assessment, then a provision of EFH Conservation Recommendations, and finally a response by the Federal agency to NOAA Fisheries (National Marine Fisheries Service, 2004, pp. 2.2-2.3).

EFH consultations may be abbreviated or expanded. In the abbreviated consultation, the federal agency submits an EFH assessment to NOAA at least 60 days before a final decision on an action. NOAA then must respond within 30 days with recommendations; the Federal agency has 30 days to respond to the recommendations as per 50 CFR 600.920(k)(1). In the expanded consultation, the Federal agency has 90 days to submit its EFH assessment with information as identified under 50 DFR 600.920(e)(3) and (4). NOAA Fisheries then reviews the action and site visits and make Conservation Recommendations within 60 days of receiving the Assessment. The federal agency must then respond within 30 days (National Marine Fisheries Service 2004, pp. 4.2-4.3).

EAs and EISs for NEPA processes also require an Endangered Species Act (ESA) Assessment and Consultation. According to FWS:

> The ESA specifically charges the Secretaries of the Interior and Commerce with the responsibility to identify, protect, manage, and recover species of plants and animals in danger of extinction… (16 U.S.C. Sec. 1531[1]) … [M]any Federal laws recognize the importance of aquatic resources. These laws outline the roles of Federal agencies to protect, restore, and conserve aquatic resources, and to provide for and enhance fisheries and recreational uses; some apply only to activities undertaken, permitted, licensed, or funded by a Federal agency (No date-a, p. 1).

Executive Order 12962 of the Recreational Fisheries particularly addresses the role of federal agencies in improving "the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities" and requires them "to aggressively work to promote compatibility and reduce conflict between administration of the ESA and recreational fisheries" (FWS, No date-a:1).

The ESA is administered by the Fish and Wildlife Service and NOAA Fisheries. Section 7(a)(1) mandates all Federal agencies to carry out programs for the conservation of endangered and threatened species (FWS, No date-b, p. 1). Under ESA §7, consultation between the Secretary and the Federal agency authorizing, funding, or carrying out an action may be concluded within 90 days, but may be extended up to 150 days if a license or permit is required (Institute of Public Law, University of New Mexico, No date, p. 1).

After a request for a lease is submitted, MMS reviews the existing NEPA documents and prepares additional documents to satisfy NEPA requirements. Required information includes: sand borrow site, volume of sand required, length of project, timeline estimated for completion, essential fish habitat, endangered species, archeological reviews, and associated comments. Once the NEPA work is completed, terms and stipulations are created to accompany the lease document. If a federal agency requests a lease, a Memorandum of Agreement (MOA) is prepared with attached terms and stipulations, reviewed, and signed by both agencies. If a non-federal entity is requesting a lease, a negotiated lease is prepared with attached terms and stipulations, reviewed, and signed by both parties. Once the lease is signed, MMS sends letters of notification to the U.S. Senate and House of Representatives, under PL 103-426. In whole, the approximate time for completion of a non-competitive lease is four to six months.

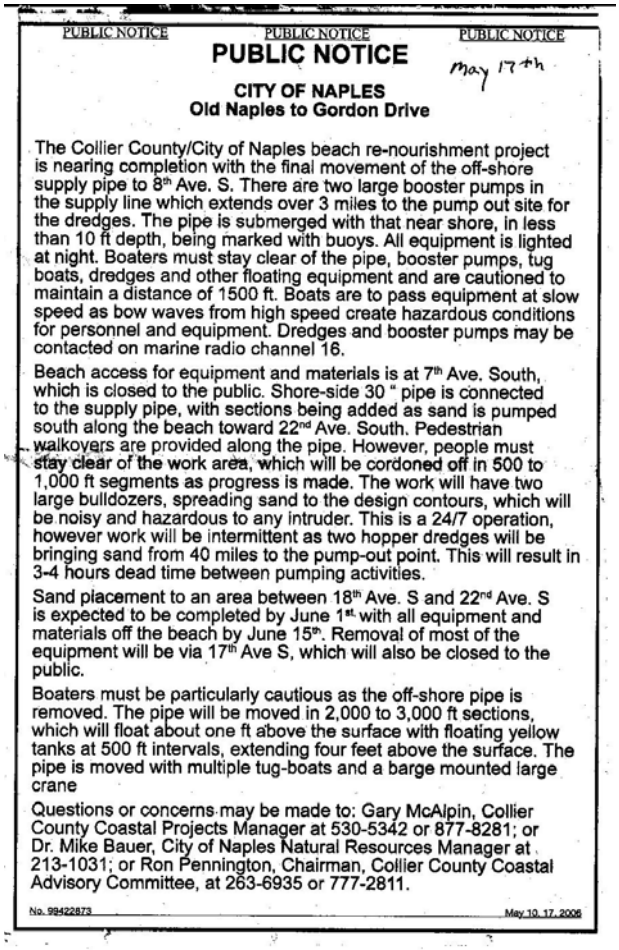
Application Stages at the Local and County Level. At the local or county level, the permit process generally begins with initial surveys, often requested by relevant agencies. In Brevard and Collier Counties, for example, permits were required from the USACE, federal and state Fish and Wildlife departments, the Florida Department of Environmental Protection, and finally MMS. A permit is granted when a permitting agency concludes it has all the information necessary to allow a process to proceed. In the State of Florida, the FDEP permits are granted through a process of data submission by the county or city through survey work, followed by a FDEP "Request for Additional Information". This two-step process is often repeated several times, becoming a cycle that a county or city is required to work through until FDEP is satisfied that it has all the information it needs to make an informed decision.

The FDEP plays a central role in overseeing and monitoring the effects of renourishment projects along the state's coast. After a dredge project has been completed, FDEP ensures annual beach surveys and monitoring take place for all beaches that are renourished.

If a project is a Corps-sponsored project, the USACE will oversee the dredging activity in state and/or federal waters, and permitting must take place through this agency. All dredging processes are established by the state Department of Environmental Protection and the USACE. Both Florida state and federal departments of Fish and Wildlife must also be consulted.

During the Collier County process, extensive survey work was required, during which a large number of hard bottom areas were found to be environmentally active. This finding required additional protection by FDEP. Input was also required from the Florida Department of Fish and Wildlife. When the initial borrow site was found to have a high silt content, the borrow site was moved 33 miles offshore, requiring additional permits from MMS. FDEP came several times to map the bottom and sent down divers to look for coral and other growth. These explorations determined the width of the beach allowed (100 feet and in some areas only 70 feet) and where to install the pumping pipes without damaging the coral. FDEP also required the county to modify the pipe with large tire-like tubes to elevate it off the sea bottom to protect the coral, and to build an acre of artificial reef in 10-14 feet of water to offset any coral areas damaged. Total estimated cost was roughly $1 million.

Once the permits were acquired, the city advertised for bids, working first from a short list and then moving to final bids. As required by the FDEP, the city ran notices in the county papers. On their own initiative; the city of Naples ran large (9 to 10 inches in length) weekly public notices in their newspaper (see Figure 6). The award was made to Great Lakes Dredge and Dock.



PUBLIC NOTICE PUBLIC NOTICE PUBLIC NOTICE

PUBLIC NOTICE

May 17th

CITY OF NAPLES
Old Naples to Gordon Drive

The Collier County/City of Naples beach re-nourishment project is nearing completion with the final movement of the off-shore supply pipe to 8th Ave. S. There are two large booster pumps in the supply line which extends over 3 miles to the pump out site for the dredges. The pipe is submerged with that near shore, in less than 10 ft depth, being marked with buoys. All equipment is lighted at night. Boaters must stay clear of the pipe, booster pumps, tug boats, dredges and other floating equipment and are cautioned to maintain a distance of 1500 ft. Boats are to pass equipment at slow speed as bow waves from high speed create hazardous conditions for personnel and equipment. Dredges and booster pumps may be contacted on marine radio channel 16.

Beach access for equipment and materials is at 7th Ave. South, which is closed to the public. Shore-side 30 " pipe is connected to the supply pipe, with sections being added as sand is pumped south along the beach toward 22nd Ave. South. Pedestrian walkovers are provided along the pipe. However, people must stay clear of the work area, which will be cordoned off in 500 to 1,000 ft segments as progress is made. The work will have two large bulldozers, spreading sand to the design contours, which will be noisy and hazardous to any intruder. This is a 24/7 operation, however work will be intermittent as two hopper dredges will be bringing sand from 40 miles to the pump-out point. This will result in 3-4 hours dead time between pumping activities.

Sand placement to an area between 18th Ave. S and 22nd Ave. S is expected to be completed by June 1st with all equipment and materials off the beach by June 15th. Removal of most of the equipment will be via 17th Ave S, which will also be closed to the public.

Boaters must be particularly cautious as the off-shore pipe is removed. The pipe will be moved in 2,000 to 3,000 ft sections, which will float about one ft above the surface with floating yellow tanks at 500 ft intervals, extending four feet above the surface. The pipe is moved with multiple tug-boats and a barge mounted large crane

Questions or concerns may be made to: Gary McAlpin, Collier County Coastal Projects Manager at 530-5342 or 877-8281; or Dr. Mike Bauer, City of Naples Natural Resources Manager at 213-1031; or Ron Pennington, Chairman, Collier County Coastal Advisory Committee, at 263-6935 or 777-2811.

No. 99422873 May 10, 17, 2006

Figure 6. Public Notice of Dredge Activity (City of Naples, 2006).

As with federal leases, time factors can slow the state and county level process as well, particularly if several "Requests for Additional Information" are required. Up to 30 days is allowed for a response by either the lessee or the FDEP after the submission for a permit is made. That is, FDEP has 30 days to respond to request for a permit and request additional information; the lessee has 30 days to gather the required information for the Request for Additional Information and re-submit a request. FDEP then has 30 days to respond to the new request and make additional requests for information. The process can potentially volley back and forth many times before a settlement is made and a permit granted. Consequently, months and even years may pass before a permit is granted. In the case of Collier County, over two years passed from the time they initiated a request for a permit and the time of dredging.

2.5 Brevard County, Florida

Brevard County is located along the east-central coast of Florida. Some of its largest population centers include: Cape Canaveral Beach (pop. 8,829), Cocoa (16,412), Cocoa Beach (12,800), Indialantic (2,944), Malabar (2,622), Melbourne City (8,829), Merritt Island (36,090), Mims (9,147), Palm Bay (79,413), Port Saint John (12,112), and Titusville (40,670) (U.S. Census Bureau, 2000). Patrick Air Force Base (2,000) and Melbourne Beach (71,382) are located on a barrier island bordered by the Atlantic Ocean to the east and the Banana River Lagoon to the west. Titusville is the county seat.

The tourism and retirement industries are at the heart of the Brevard County economy. This coastal region is known for its sub-tropical, temperate weather, as well as its beaches and local amenities. As a result, the north beach areas of Brevard County have developed into a retirement-vacation-recreation complex. Although Cocoa Beach has only 12,800 full-time residents, tourists swell this count to 30,000 during peak seasons, filling the multitude of hotels, motels, timeshares, and condominiums lining the beach. Not surprisingly, the tourism industry supports a relatively large labor force. In 2000, 19 percent of the county's labor force was employed in retail trade, 5.5 percent in finance, insurance and real estate, 4 percent in transportation, and 2 percent in entertainment and recreation services (U.S. Census Bureau, 2000).

Port Canaveral is a vital contributor to the county's economy. The port is located midpoint between Miami and Jacksonville and 50 miles east of Orlando; it is the only deep water port between Fort Lauderdale and Jacksonville. Sandwiched between Cape Canaveral Air Force Station to the north and Patrick Air Force Base to the south, the port has a long military history. Presently, it is home to the *Trident* nuclear submarine. NASA's John F. Kennedy Space Center is also located just north of the port and immediately adjacent to the study area.

Port Canaveral is also home to Brevard County's largest concentration of fishermen, both commercial and charter. While the fishing industry does not generate the same amount of revenue as tourism, it remains important to the local economy and is inherently tied to tourism. The region is known for its seafood, such as rock shrimp, which is served in many of the local seafood restaurants. Tourists frequently visit the port to purchase seafood in retail shops and to take charter trips to catch their own.

2.5.1 Sand Mining Activities in Brevard County

Florida's eastern beaches have become a focal point for the state, federal, and local governments, who together are addressing the impacts of annual weather patterns on local economies. Hurricanes that occur annually in the southeast U.S. sweep away large sections of Florida's beaches each year, including those between Cape Canaveral and Melbourne Beach. These hurricanes, coupled with the major man-made inlets in the area used for commercial shipping and recreational boating, "severely affect the flow of some 600,000 cubic yards of sand that move southward each year from Georgia" (Finotti, 2003).

Brevard County's history of sand dredging is more extensive than in other Florida counties because of its position as host to Port Canaveral, which was originally developed as a naval port in the 1950s. Dredging has occurred in the local area since at least 1966, when federal funding facilitated the movement of 120,000 cubic yards of aggregate for navigation purposes (Table 11). Home to the *Trident*, this port must accommodate deep drafts.

In other cases, dredging in Brevard County has replaced sand lost to seasonal storms and hurricanes, as well as to erosion. In 1972, 1994, 1996, 2002, and 2005, Brevard County has initiated beach renourishment projects to maintain and stimulate its tourism and retirement economic sectors.

Table 11

History of Dredging Activity in Brevard County

Beach	Date	Funding Source	Purpose	Volume (cubic yard)	Length (feet)	Cost in 2003 Dollars
Cape Canaveral/ Cocoa Beach	1966	Federal	Navigation	120,000	--	$773,720
Cape Canaveral/ Cocoa Beach	1972	Federal	Erosion	200,000	--	$1,273,315
Cape Canaveral/ Cocoa Beach	1975	Federal	Navigation	2,715,000	11,088	$3,199,842
Cape Canaveral/ Cocoa Beach	1994	Federal	Erosion	100,000	5,100	$236,832
Cape Canaveral/ Cocoa Beach	1995	Federal	Navigation	742,000	--	$4,438,072
Cocoa Beach	1996	Federal	Erosion	40,000	2,500	$409,018
South Brevard	2002	State/local	--	1,100,000	15,840	$3,051,906

Source: Duke University, 2005.

In 1996, Congress granted federal authorization to the Brevard County Shore Protection Project. This project involved the initial and ongoing restoration of the North and South Beaches of the County coastline. It was jointly managed by USACE and the Brevard County Natural Resources Management Office. The initial renourishment project began in 2000 and was completed in 2003. However, due to the 2004 hurricane season and naturally occurring erosion events, much of this sand was lost. In March and April 2005, federal emergency funds were appropriated to restore the project's areas. In all, 83 percent ($14 million) of the cost for renourishment was covered by federal government funding. The remaining 17 percent ($2.6 million) was covered jointly by the State of Florida and Brevard County. Through its Strategic Beach Management Program, the state covered 8 percent of the project costs. Brevard County's 9 percent was covered through a Local Option Tourist Development Tax placed on local hotels and motels (Brevard County, 2005c).

Unlike its past dredging projects, the 2005 restoration project mined sand from Canaveral Shoals. Because Canaveral Shoals is located in federal waters, this sand borrowing required MMS involvement. The contract for renourishing various sections of Brevard County's beaches was awarded to Weeks Marine, Inc. The South Beach project was then subcontracted to Bean Stuyvesant, LLC., while Weeks Marine, Inc. maintained operations in North Beach. Roughly 1,333,500 cubic yards of sand were placed along the North and South beaches of Cape Canaveral, Cocoa Beach, Indialantic, and Melbourne Beach. Two hopper dredges were deployed for the project in the North Beach of Cape Canaveral. Each had a transportation capacity of 4,000 cubic yards of sand. One hopper dredge, the Stuyvesant–which is the largest hopper dredge operating in U.S. waters (holding up to 6,400 cubic yards of sand) – was deployed to the South Beach operation. Only one hopper dredge was employed by Bean Stuyvesant (Brevard County, 2005d).

The majority of Brevard County's dredging activity occurred in Canaveral Shoals, which is located approximately three to four miles northeast of the mouth of Port Canaveral. In terms of navigation, the shoals lie almost directly in front of the Port, but a few miles out. Fishermen typically navigate to the south of these shoals because a federal security zone surrounds the coastline immediately north of the port's mouth. In the South Beach project, the dredging operation transported sand southward first and then onto shore. The sand was transported to an offshore pump-out buoy where it was hydraulically pumped through a pipeline to the beach nourishment area. As illustrated in the figure below, onshore pipelines provided an efficient means to distribute sand (Figure 7).

Figure 7. Pipeline along the Cocoa Beach Shoreline (IAI, 2005).

2.5.2 Overview of Commercial and Recreational Fishing Activities in Brevard County

2.5.2.1 Introduction to Commercial Fishing in Brevard County

As in many other coastal Florida counties, commercial and recreational fishing activities are important components of the Brevard County economy. Moreover, commercial fishing is important to the state economy; Brevard County's landings for invertebrates, finfish, and shrimp combined contributed 5 percent of Florida's total landings in 2005.

Of the total seafood landings brought onto Brevard County docks, invertebrates comprise the largest share. In 2005, for example, invertebrates (non-shrimp) comprised 47 percent of all landed seafood. In that same year, finfish accounted for 39 percent of Brevard County's landings; the shrimp fishery is less productive, contributing only 14 percent (see Table 12).

Table 12

2005 Annual Landings Summary by Fish Type: Brevard County, Florida

Type of Fish	Brevard County				State of Florida			
	Landings in Pounds (lbs)	% of Total Landings	Number of Trips	% of Total Trips	Landings in Pounds (lbs)	% of Total Landings	Number of Trips	% of Total Trips
Finfish (all)	1,869,037	39.2	4,637	37.4	49,548,491	54.8	84,779	41.0
Invertebrates (non-shrimp)	2,223,606	46.6	7,535	60.9	20,303,019	22.4	96,480	46.6
Food Shrimp	679,481	14.2	206	1.7	18,944,684	20.9	10,166	4.9
Bait Shrimp	20	>1	2	>1	1,634,260	1.9	15,595	7.5
Grand Total	**4,772,144**	**100.0**	**12,380**	**100.0**	**90,430,454**	**100.0**	**207,020**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

Consistent with a state-wide mandate, Brevard County fishermen are restricted from fishing near-shore waters, which are under State jurisdiction up to three miles offshore. The majority of fishing takes place either inshore in the inland waterways, rivers, and lagoons, such as Banana River, or offshore in federal waters. The main fishing activities inland include potting for crab, dredging for scallops, or leisure angling. Scallop dredging has declined significantly over the past several decades, while crabbing and angling continue to contribute to a vibrant regional fishing economy. The main fisheries offshore include white and rock shrimp and finfish.

2.5.2.2 The Crab Fishery

Non-shrimp invertebrates are Brevard County's largest fishery in terms of pounds landed, representing 47 percent of the county's seafood harvest and 11 percent of Florida's total invertebrate harvest (Table 12). Blue crabs account for Brevard County's largest invertebrate harvest. In 2005, nearly 2.2 million pounds of hard-shell blue crabs were landed in the county. This harvest represented 99 percent of Brevard County's total invertebrate harvest (Table 13).

Table 13

2005 Annual Landings Summary for Invertebrates (non-shrimp):
Brevard County, Florida

Invertebrates			Brevard County			State of Florida		
Species	**Landings Pounds (lbs)**	**% Total Invertebrate Landings**	**No. of Trips**	**% of Total Invertebrate Trips**	**Landings Pounds (lbs)**	**% of Total Invertebrate Landings**	**No. of Trips**	**% of Total Invertebrate Trips**
Clams	13,676	0.6	987	12.7	140,811	0.8	2,553	2.9
Crab, Blue (hard)	2,191,440	98.6	6,287	81.1	11,501,262	62.8	38,892	45.5
Crab, Blue (soft)	1,228	>1	200	2.6	100,788	0.5	2,187	2.5
Crab, Stone (claws)	1,240	>1	94	1.2	2,283,513	12.4	24,202	28.3
Lobster, Spanish	10	>1	2	>1	9,132	>1	61	>1
Lobster, Spiny	12,265	0.5	121	1.6	3,376,817	18.4	16,697	19.5
Squid	476	>1	4	>1	25,438	>1	385	0.4
Misc. Invertebrates	2,786	>1	58	0.7	868,812	4.7	553	0.6
Total Invertes.	**2,223,121**	**100.0**	**7,753**	**100.0**	**18,306,573**	**100.0**	**85,530**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

The majority of Blue crab harvesting takes place in the inland waterways south of Port Canaveral, away from sand-mining activity. Therefore, the potential for conflict between Port Canaveral crab fishermen and dredge operators from this project is minimal.

2.5.2.3 The Finfish Fishery

Finfish also constitute an important fishery in the Brevard County commercial fishing industry. In terms of pounds landed, Spanish mackerel and shark account for 51 percent of all finfish caught in 2005 (Table 14).

Table 14

Annual Finfish Landings (select) by Type of Fish Caught in Excess of 10,000 Pounds:
Brevard County, Florida, 2005

FInfish	Brevard County				State of Florida			
Species	Landings Pounds (lbs)	% Total Finfish Landings	No. of Trips	% Total Finfish Trips	Landings Pounds (lbs)	% Total Finfish Landings	No. of Trips	% Total Finfish Trips
Bait Fish	35,070	2.0	253	3.0	504,537	1.9	1,455	1.4
Blue Runner	31,931	1.8	545	6.5	156,016	0.5	4,503	4.5
Bluefish	84,601	4.8	240	2.8	180,029	0.6	3,664	3.7
Dolphin	20,197	1.1	129	1.5	346,101	1.3	3,144	3.1
Flounder	29,141	1.7	338	4.0	266,615	1.0	5,039	5.0
Grouper, Gag	22,833	1.3	221	2.6	2,796,093	10.6	6,384	6.4
Kingfish	41,406	2.4	1,064	12.7	806,193	3.0	3,748	3.7
Mackerel, King	181,389	10.4	1,031	12.3	3,298,545	12.6	13,133	13.2
Mackerel, Spanish	520,527	29.9	726	8.7	4,252,051	16.2	6,862	6.9
Mullet, Black	115,148	6.6	986	11.8	6,656,563	25.4	21,071	21.2
Pompano	17,365	1.0	718	8.6	324,220	1.2	5,703	5.7
Shark	414,376	23.8	439	5.2	3,064,513	11.7	1,834	1.8
Sheepshead	24,231	1.4	504	6.0	326,777	1.2	9,560	9.6
Snapper, Red	11,778	0.7	248	3.0	655,899	2.5	2,796	2.8
Swordfish	22,456	1.3	22	0.3	770,263	2.9	487	0.4
Tilefish, Golden	135,894	7.8	46	0.5	537,309	2.0	562	0.5
Tunny, Little	13,938	0.8	192	2.3	337,213	1.2	2,230	2.2
Misc. Food Fish	19,292	1.1	654	7.8	865,726	3.3	6,840	6.9
Total Finfish	**1,741,573**	**100.0**	**8,356**	**100.0**	**26,144,663**	**100.0**	**99,015**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

2.5.2.4 The Shrimp Fishery

In terms of pounds landed, shrimp is Brevard County's smallest fishery. In 2005, commercial fishermen harvested 6.7 thousand pounds of food shrimp, with white shrimp constituting the majority of the landings (77%) (Table 15).

Table 15

Annual Shrimp Landings: Brevard County, 2005

Invertebrates	Brevard County				State of Florida			
Species	Landings Pounds (lbs)	% Total Shrimp Landings	No. of Trips	% Total Shrimp Trips	Landings Pounds (lbs)	% Total Shrimp Landings	No. of Trips	% Total Shrimp Trips
Shrimp, Brown	41,998	6.3	26	11.6	1,966,093	10.5	1,713	17.7
Shrimp, Pink	4,190	0.6	7	3.2	10,872,802	58.2	3,542	36.5
Shrimp, Rock	53,853	7.9	12	5.4	598,944	3.2	546	5.6
Shrimp, Royal Red	53,849	7.9	3	1.3	153,136	0.8	13	0.1
Shrimp, White	525,590	77.3	175	78.5	5,088,244	27.2	3,879	40.0
Total	**679,480**	**100.0**	**223**	**100.0**	**18,679,219**	**100.0**	**9,693**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

2.5.2.5 Introduction to Recreational Fishing in Brevard County

The recreational fishing industry in Brevard County is also economically significant. In the 1999-2000 fiscal year, 23,513 resident saltwater fishing licenses were sold, bringing in $282,156 in license revenue. In that fiscal year, Brevard County ranked eighth in the state in terms of revenue earned from the sale of resident saltwater fishing licenses (Stephan and Adams, 2001).

Charter boat fishing is also a major industry in Brevard County. There are more than 60 advertised charter boat and party/head boat operations running throughout the county, including Port Canaveral, Titusville, and Melbourne. The majority of charter boats, however, leave from Port Canaveral. In 2000, the charter boat industry employed more than 50 full time employees (Braun and Xander, 2001). Offshore fishing trips typically run 20 to 30 miles to the outer reefs, although fishing trips targeting larger species will run to the Gulf Stream, nearly 100 miles out. Commonly fished offshore species include: marlin, grouper, and tuna. Inshore charter trips run throughout Mosquito Lagoon, Indian River Lagoon, St. Johns River, Banana River, and Sebastian Inlet. Commonly fished inshore species include: redfish, snook, spotted trout, black drum, tarpon, and ladyfish.

2.5.3 The Port Canaveral Fishery

The Port. Port Canaveral, a man-made harbor facility, was dedicated in 1953. At that time, the commercial fishing industry was one of the region's primary employment sectors. The industry gained momentum in 1968 with the advent of the rock shrimp fishery. The port's inlet is one of the safest on Florida's eastern coastline. Many private boaters, commercial shipping vessels, and charter boat fleets travel through it each day.

Port Canaveral is also the second busiest cruise port in the world. Several large cruise ships, including Carnival, Royal Caribbean International, Holland America, and Disney, dock and maintain offices at the west end of the port. A recreational boat launch and county park are located just beyond this docking area. The Port Authority, several container ships, and a holding facility for non-contained material (e.g., sand and mulch) are located next to the county park. There are also two marinas at this port: the Cape Marina and the Sunset Marina. Both cater to charter and recreational fishermen.

The Port Canaveral channel has been an active deep-water channel since becoming home to the *Trident* nuclear submarine in the early 1980s. The Port has been subject to routine dredging operations ever since. Additional dredging activities in this channel were introduced in the mid-1980s to accommodate the increasing cruise line traffic coming into and out of the harbor.

NASA. Port Canaveral lies in close proximity to the John F. Kennedy Space Center in Cape Canaveral. The space shuttle and rocket launches have created permanent off-limit security zones near the base. NASA's activities also result in temporarily expanded security zones and large restricted fishing areas during launches. The Kennedy Space Center Security Zone (165-701), which was originally located near shore, was expanded following the terrorist attacks of September 11, 2001. This Security Zone now extends roughly three miles offshore. The expanded security zone also includes long-used bait catching locales, such as the Cape Canaveral bight. Additionally, security officials, always present in the harbor, have increased the frequency of routine security checks. As such, fishing from the port necessitates continual adaptation.

2.5.3.1 Commercial Fisheries in Port Canaveral

Port Canaveral is home to a large seasonal commercial fishing fleet, which includes shrimp, scallop, and long-line fishing vessels. The primary commercial fishermen are shrimpers and fin fishermen. Commercial fishing has been an economic staple of port life since the mid-1960s. However, as elsewhere in the U.S., the Port Canaveral commercial fishing fleet has been fraught with economic difficulties related to increasing operational costs and regulations, and a decline in dockside seafood prices.

A number of commercial fishing facilities line the water's edge. These include two shrimp houses, two fish houses, and the remnants of a now-defunct scallop plant and fish house. Several shrimp boats parked parallel along the fish/shrimp house fronts. The large restaurant-and-casino-boat complex is located in the middle of the commercial fishing docking area. This commercial fishing area is surrounded by charter fishing areas, recreational boat launches, restaurants, cargo facilities, and cruise ships. Given this spatial layout, it becomes clear that the sentiment expressed by commercial fishermen of "being squeezed out" is as much physical as economic.

Major Fisheries. Despite being the smallest fishery in Brevard County as a whole, the shrimp fishery in Port Canaveral, where most fishermen are shrimpers, is very productive. The majority of shrimpers harvest both white and rock shrimp; the fin fishermen primarily target shark. White shrimp season runs from March to June, and October to December; rock shrimp season runs from mid-April to October, peaking in August. Finfish season varies by species (grouper season, for example, begins January 1; Spanish mackerel season begins November 15) and ends when strictly regulated catch quotas are filled (Florida Fish and Wildlife Conservation Commission, 2004). Because of the seasonal nature of the fisheries, many of the shrimpers come from other areas to trawl the near-shore waters of Brevard County, using Port Canaveral as a temporary home base (Figure 8).

Figure 8. Commercial Shrimpers in Port Canaveral (IAI, 2005).

Wholesale and Retail Seafood Markets. There are four fish/shrimp houses on port grounds: *Canaveral Shrimp Company, Bluepoints International, Wild Ocean Seafood Market,* and *Seafood Atlantic Wholesale and Retail Market.* These four fish markets maintain a steady business. The first three deal only in shrimp; the fourth, *Seafood Atlantic*, purchases multiple types of seafood and fish from commercial fishermen. Both *Wild Ocean* and *Seafood Atlantic* are retailers; the *Canaveral Shrimp Company* and *Bluepoints International* are wholesalers.

An Industry in Decline. There were once six thriving fish houses on port grounds. Two of these went out of business in the mid-1990s. A scallop processing plant, which in its heyday in the 1980s operated around the clock, closed following a collapse in the scallop fishery. According to one fisherman, "There hasn't been much scalloping [here] in the last three to five years" (Goddes, oral commun., 2005). *Fishes Seafood*, the other now defunct fish house, had been the largest in Port Canaveral and "the best [house] to fish for".

The bare, cement foundation of the scallop factory and the empty shell of *Fishes Seafood* are daily reminders of an industry in decline. One long-time fisherman in the port recalls a time in the early 1970s, when "There was only one charter boat and 60 commercial fishing boats". According to this informant, now there are 60 charter boats and only 20 full-time commercial fishermen. Cape Canaveral fishermen with whom we spoke for this research generally cited four (4) main reasons for the decline in the number of commercial fishing vessels proportional to the rise in the charter industry: (1) rising operation costs; (2) declining marine resources; (3) increasing state and federal regulations; and, (4) changing demographics. Rising operation costs include fuel, dockage, insurance, electronics, and general overhead. Declining marine resources refer to the collapse in the scallop fishery. The state-imposed net ban (in the rivers and within three miles of the shoreline) is the most recent regulation driving commercial fishermen from the industry. Finally, changing demographics refer to a rise in the "baby boomer" population – a population with more disposable income to spend on recreation such as charter boat fishing.

According to local fishermen, the 1994 Florida State net ban, along with the National Marine Fisheries Service's regulations on fishing seasons and bycatch, is significantly affecting recent participation in the commercial fishing industry. The net ban, which limits net fishing to outside of three miles from shore, resulted in the egress of fishermen from the industry who could not afford the increased costs associated with offshore fishing. Later extended to include inland waterways, the net ban also put an end to commercial fishing there as well.

Although accelerated in recent years, the fishing industry in Brevard County has been in decline for the past fifty years. This decline is reflected in U.S. Census Bureau data. In 1952, 1,341 people were employed in the agriculture, forestry, fishing, and mining industry, and comprised 16.2 percent of the county's labor force (U.S. Census Bureau, 1953, p. 126). Although 3,437 persons were employed in agriculture, forestry, and fishing in 1990, this number represents only 2 percent of the labor force. By 2000, only 1.3 percent of the labor force worked in this sector. Contrastingly, the retail trade industry has greatly expanded. In 1990 this industry employed 13 percent of labor force, but employed 19 percent by 2000 (U.S. Census Bureau, 2000).

Spatial Distribution of Commercial Fishing Activity. The topography of the ocean floor dictates in part where particular types of fishing activities occur. Several reef complexes offshore of Port Canaveral extend toward the continental shelf, along which the Gulf Stream runs and beyond where deep water canyons lie. Approximately 30 miles from shore, beginning off the port and running south from Fort Pierce, is a long, narrow reef called Catri's Reefs. Past this reef, the ocean floor drops steadily and rapidly from 45 feet to roughly 350 feet where the Gulf Stream flows northward. Past the Gulf Stream, the ocean floor drops again, forming several deep canyons that include Fort Pierce, Melbourne, Capt. Dwyer's, and Canaveral Canyons. Most fishing activities, including commercial and charter operations, take place on the inshore side of Catri's Reefs, where numerous other reefs (shelves) are located.

Fishing Locales. Commercial shrimpers fish close to shore for white shrimp (three to five miles) and further out on the sandy flats for rock fish (30 to 50 miles). Most bottom fishermen (long-liners) fish the offshore reefs, including Pelican Flats and Catri's Reef. "Sharkers," however, fish in waters closer to shore, often alongside the commercial shrimpers (Figure 9).

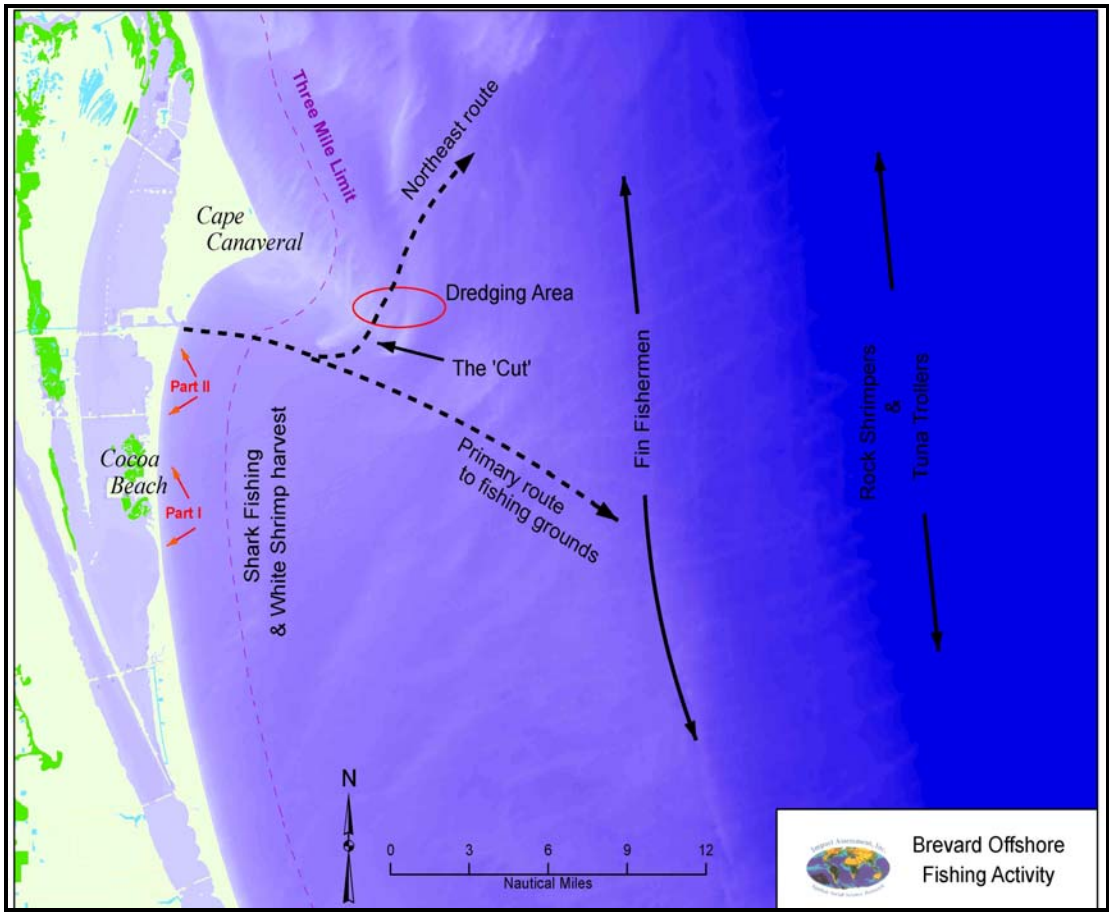


Figure 9. Brevard County: Location of Fishermen by Target Species, Dredging Area, and "the Cut" (IAI, 2006).

Regarding navigation routes, nearly all fishermen with whom we spoke travel southeast out of the port, turning southward within three miles of shore. Occasionally, some commercial bottom fishermen turn northeast within three miles of shore, traveling through what is termed "the Cut" (see Figure 9 above). "The Cut" is a channel located in the center of Canaveral Shoals. It provides quick access to the reefs located in the waters north of the Port. However, because "the Cut" lies in federally active waters subject to restrictions during shuttle launches, the majority of commercial fishermen described the waters south of the Port as their primary navigation route and fishing area.

The dredge path for this particular project runs from Canaveral Shoals south, turning southwest. At the same time, the principle commercial fleet navigation route runs due east, turning southeast; thus the hopper dredge and fishing fleet occasionally cross paths.

2.5.3.2 Recreational Fisheries in Port Canaveral

Port Canaveral is home to the largest charter fleet in Brevard County. Cape Marina holds roughly 30 charter boats and many more recreational boats (Figure 10). The Cape Marina is also one of the port's haul-out and maintenance areas. The Sunset Marina houses another 30 or so charter boats.

Figure 10. Charter Boats Harbored at Cape Marina (IAI, 2005).

Spatial Distribution of Charter and Recreational Fishing Activity. Most charter operations travel to the outer reefs, such as Catri's, to fish the inshore side. Charter fishermen typically travel 20 to 30 miles offshore to the first set of reefs to catch grouper, snapper and other bottom fish. Pelican Flats is another popular location for charter fishermen, because it is relatively close to shore and requires less fuel than other offshore trips. Sport fishermen in search of tuna and game fish may travel 100 miles or more offshore.

2.5.4 Brevard County Concerns about Sand Dredging Activities

2.5.4.1 Study Results

Identifying General Industry Concerns: The concerns voiced by Brevard County fishermen ranged from general industry-related concerns such as rising fuel costs, to those specific to working in the Port Canaveral area. Concerns also varied by type of fishing activity. Their primary dredge-related concerns are tabled below (Table 16). All fishing-related concerns broached by discussants are described in more detail in Appendix II.

Table 16

Dredge-related Concerns Generally Shared by Industry Participants in Brevard County

Dredge-related Concern	Commercial Fishermen	Charter Fishermen	Recreational Fishermen
Offshore dumping of spoil material from port	Yes	Yes	No
Dredging offshore shoals breaks-up heavy seas	Yes	No	No
Poor water clarity	No	Yes	No

Source: IAI, 2005.

Port Dredging versus Mining of Canaveral Shoals. Overall, commercial and charter fishermen were more concerned about port dredging than offshore sand mining in respect to how it may impact their livelihood. Bathymetric changes that could translate into less protection from heavy seas and changes in what locally is known as "the Cut" was the only concern aired about offshore sand mining in the Canaveral Shoals. Overall, however, fishermen did not perceive port dredging itself as a major problem. To the contrary, they viewed dredging as part of the regular, on-going port maintenance that, like specific regulations governing port activity, was unavoidable. Instead, their major concern with port dredging was with the dumping of spoil materials offshore. This material is qualitatively different from the sand that lies off of Canaveral Shoals. Both commercial and charter fishing participants believed that dumping the spoil materials silted the outer reefs, thereby diminishing food sources for fish which, in turn, affected finfish landings. However, while some fishermen link diminished finfish landings to sand mining operations, others hold that it results from natural causes.

Transformation of Wave Energy. A wide-ranging body of literature exists on the observed biological and oceanographic effects of dredging. Much of this literature, though, addresses the effects of dredging activities on benthic communities (Cerame-Vivas and Gray, 1966; Collie et al., 2000; Watling and Norse, 1998). Watling and Norse, for example, show that dredging harbor seabeds and navigation channels causes both physical disturbance and contaminant dispersal (1998, p. 1,186). More recently, Kelley et al., (2001) conducted a numerical modeling analysis on the effects of shoal dredging in federal waters on changes to inshore currents.

Although the Port Canaveral fishing community members who contributed to this study did not express concern about the effects of dredging upon the well-being of benthic communities per se, many contended that port channel dredging directly affects the water quality on the inner reefs (e.g., Pelican Flats) and consequently the intensity and duration of the feeding cycles of the bottom fish population in the reef area.

There is also a body of literature on wave energy changes due to physical disturbance of seabed and bathymetry associated with marine aggregate dredging. This literature validates concerns with transformations in wave height and force associated with offshore dredging (Watling and Norse, 1998; Kelley et al., 2001). Literature on wave energy change in general commonly relates effects of wave transformation to coastal erosion and storm surge, but it is beginning to take into consideration the importance of wave alteration on fishing communities and industry, such as loss in number of days suitable for fishing (Global Energy Partners, 2004, pp. 21-22; Tsimplis, 2004).

The vast majority of literature on sand mining activities examines the physical and oceanographic changes that may result from such activities. What is currently lacking is a body of social science literature that examines the relationship between attitudes and beliefs held by fishing participants regarding the impact of offshore sand mining and how these attitudes and beliefs contribute to the creation and/or mitigation of potential conflicts between area users. This study, in part, addresses this lack.

In this study, commercial fishermen were only marginally concerned with the potential for wave energy alteration as a result of sand mining activities, but were more concerned than charter fishermen. Recreational fishermen were not at all concerned.

Overall, fishermen were most concerned about the potential of non-natural events, such as dredging, to alter their activities and less concerned about the power of naturally occurring events to alter their activities. Natural changes, they indicated, were out of their control and therefore not worth worrying about. At the same time, dredging activities were generally of less concern if they were perceived as being for "the greater good". Events that were viewed as a violation of the natural order, however, posed considerable concern.

In the Port Canaveral area, fishermen expressed some concern that sand extraction activities around the Canaveral Shoals could potentially alter inshore currents. The Port's mouth, by and large, is protected by the Cape to the immediate north, and, more importantly, the shoals that naturally accumulate off the tip of the cape. Fishermen perceive any alteration to these shoals as potentially detrimental to the functioning of the fishing community by limiting the ease with which they enter and exit the Port.

Restricted Fishing Navigation Routes. As identified in the literature, many commercial fishermen link dredging activities to an increased risk for collisions because of restricted navigation routes (Simpson, 2004). In coastal Florida, however, this concern is minimal because dredging operations are not long-term and operations within state and federal waters are subject to standard navigational control. Rather, some fishermen are concerned that sand mining activities could fill the "the Cut," thus eliminating a convenient navigational shortcut across the Shoals. Fishermen favor this route because it saves them time and fuel costs, especially when regular navigational zones are restricted during NASA rocket launches. However, because most commercial fishing occurs southeast of the Port's mouth, commercial fishermen do not depend on "the Cut" to reach their primary fishing grounds. Additionally, most fishermen also believe that natural circumstances, such as storm surge and currents, are as likely to close "the Cut" as dredging.

Approximately one-third of the commercial fishermen who offered their opinions said they used the Cut either to leave or return to the port area. However, most fishermen who used the Cut believed that the shoals are naturally shifting anyway and that offshore dredging might simply make navigation a bit more difficult.

Approximately half of the charter boat captains with whom we spoke said they used the Cut either to leave or return to the port area. Similar to the commercial fishermen, however, most charter fishermen also believed that the shoals are naturally shifting and that offshore dredging might simply accelerate the process.

Concerns Vary by Fishing Activity. Overall, one's concerns about dredging are shaped by the type of fishing activity in which one is professionally engaged (Tables 17 and 18). For example, charter boat and party/head boat operators and commercial divers are more concerned about the effects of dredging on water clarity than commercial fishermen. However, there is a lack of consensus even among charter fishermen and divers as to the root cause of the increased amount of silt around the inner reefs where they fish. Many attribute poor water clarity directly to dredging activities in the port and to the subsequent dumping of spoil materials south of the port in state waters. Although others contend that the currents naturally move this spoil material away from the reefs, those who blame dredging activities point out that the reefs are covered with a "clay-like substance" that is most distinctly not sand. In contrast, commercial divers tend to regard the shoals and the surrounding waters as "naturally silty," and thus only indirectly affected by dredging activities. One diver asserts that, "Anyone diving here a long time should know this water is silty and not really clear. It gets better from Fort Pierce south". A charter boat captain offered a third explanation, attributing the increase in silt to the thermocline toward the bottom of the ocean. Significantly, two of the reigning hypotheses center on natural causes, while only one hinges upon dredging activities.

Table 17

Key Concerns with Sand Dredging in Brevard County, 2005

Concerns with Sand Dredging	Fin Fishers	Divers	Shrimpers	Charter Operators	Recreational Anglers
Affects inshore currents	Yes	Yes	Yes	Yes	No
Dredge traffic interferes with fishing navigation routes and areas	Yes	No	No	Yes	No

Source: IAI, 2006.

Table 18

Types of Conflict on Commercial Fisheries from Dredging Activities: Brevard County

Type of Reported Impact or Conflict on Commercial/Recreational Fishing Activity	Specific Impact/Conflict	Description
Direct Impacts (Primarily Economic)	Reduction in Catches/Landings	None
	Exclusion from Fishing Grounds	None
	Economic Impacts and Increases in Operation Costs	Slight increases in fuel expenditures due to changes in standard navigational routes.
Indirect Impacts (Primarily Ecological and Geological)	Potential damage to fish ecology	Said silting of reefs, possibly from sand, suffocating food sources.
	Changes to ocean floor	Possible break up of heavy seas due to removal of shoals that act as a barrier to port entrance.

Source: IAI, 2006.

The Role of Formal Networks in Shaping Community Consensus. In addition to personal experience, opinions about offshore dredging are also shaped by (1) one's perception about the necessity of the dredging activity, and (2) one's peer group; that is, how concerned one's peers were about dredging activities. In Brevard County, a great deal of effort is made to explain the dredge operation through public notices, which are posted in the local newspapers and on billboards placed in public signage areas (such as those at the entrance of beach access paths). Field discussions revealed that fishermen were generally well-informed about the purpose of the dredging operation (Figure 11).

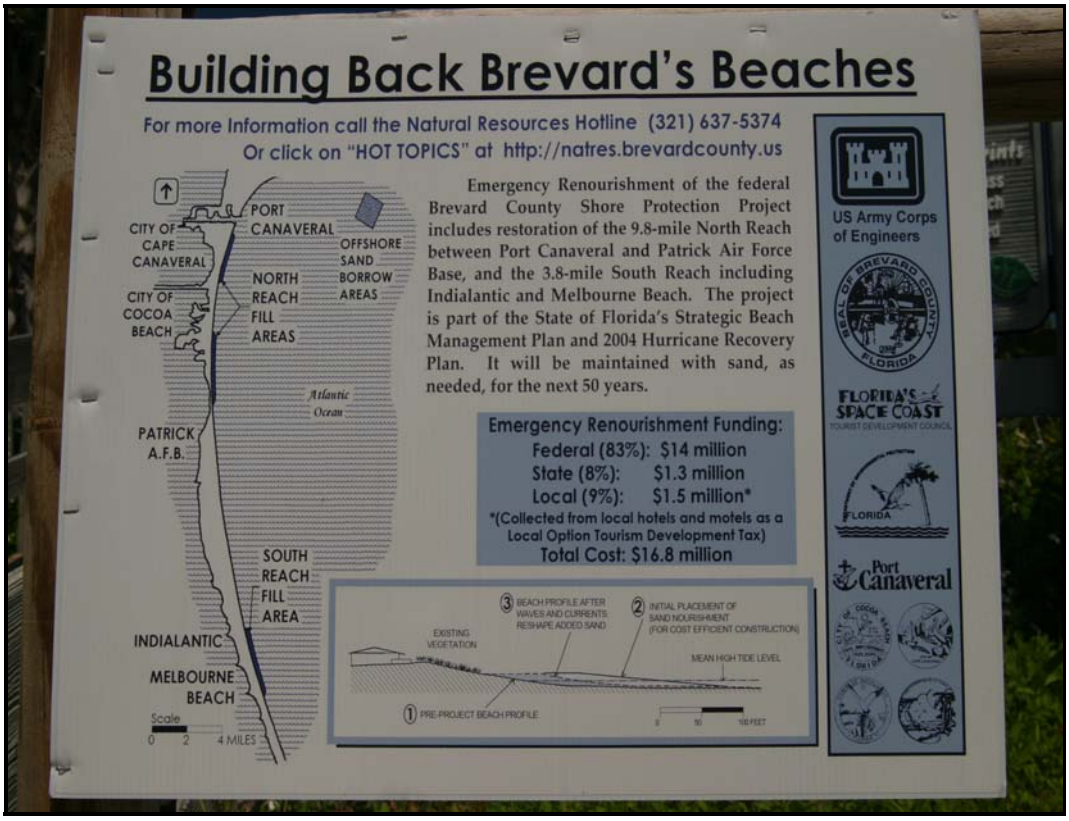


Figure 11. Advertisement for sand mining off of Canaveral Shoals (Brevard County Department of Natural Resources, March 2005b).

The Port Canaveral Charter Boat Association (PCCBA), a group of 30 or so charter boat captains, provides a resource for networking with other members, and is one of the main places where charter fishermen share and disseminate information. The Association is socially structured and managed by an official governing body (president, vice president, etc.,) and through key leaders, who are respected because of their seniority, experience, and/or charisma. Meetings occur monthly. Members of the PCCBA tended to be more concerned about the water clarity of the reefs than either charter fishermen who did not belong to the Association or commercial fishermen. Thus, membership in the PCCBA appears to have an influence on individually-held opinions about shoal dredging.

In 2006, one year later after initial fieldwork, researchers found that concerns regarding bathymetric changes and closed navigation routes previously voiced by area fishermen had dissipated. In general, conversations with fishermen revealed an attitude of acceptance of the beach renourishment project and a reduced climate for potential conflict.

2.6 Collier County, Florida

Collier County is located on the southwest coast of Florida. Lee County borders its northern perimeter, and Monroe County lies to the south. The Gulf of Mexico forms the west coast of the county. With a total area of 2,305 square miles (100 square miles water), Collier is the largest county in Florida. In 2000, there were 251,377 residents in Collier County. In that year, the four largest cities in Collier in terms of population were: Immokalee (19,763 pop.); Golden Gate (20,951 pop.); Marco Island (14,879 pop.); and Naples (20,976 pop.) (U.S. Census Bureau, 2000). Naples is the county seat.

Tourism plays a significant role in Collier County's economy. Tourism is the leading employer, employing more than 27,000 persons in 2004. In 2004, over 1.4 million tourists brought almost $7 million dollars into the county, creating a total economic impact of over $1 billion. Further, visitors brought in more than $10 million in tourist development taxes and provided $68 million in sales and gas tax revenue (Florida Travel and Lifestyles, 2006).

Not surprisingly, many enterprises in Collier County support the tourism industry and cater to tourists. In 2002, there were 731 real estate, rental and leasing establishments. These businesses brought in nearly $497 million in receipts and supported an annual payroll of over $100 million. There were also 586 food and accommodation establishments in that year, reaping $697 million in revenue and paying out over $193 million in wages. Retail trade alone supported 1,465 establishments, earning $4.2 billion in revenue and supporting an annual payroll of $422 million (U.S. Census, 2002).

Unlike Brevard County, there is no major port in Collier County, and there are no marine shipping or freight operations. Rather, Collier County's marine industry caters to recreational and sports fishermen. There are three large marinas in Naples: Gulf Shores Marina, Wiggins Pass Marina, and Naples Marina. Everglades City, once the county seat, is a popular fishing destination. The most popular game fish are snook and tarpon. Collier County's tourism industry relies in part on maintaining the high quality of its white sandy beaches to attract visitors

2.6.1 Sand Dredging Activities in Collier County

Unlike Brevard County, which has a comparatively long history of sand mining activities, sand dredging has been a part of Collier County's beach management plan since only 1983. In that year, Vanderbilt Beach, a popular tourist destination north of Naples, received 48,000 cubic yards of sand to develop its shores. Funded by local government and private interests, this project cost nearly $295,000. Thirteen years later, in 1996, Vanderbilt Beach and Naples Beach were renourished after a series of storms washed away much of the beach sand. At that time, the federal government assisted in funding the nearly $12 million project, which brought over 1.1 million cubic yards of sand to approximately 30,000 feet of shoreline (see Table 19).

Table 19

History of Beach Renourishment Projects: Collier County

Beach	Year	Funding Source	Purpose	Volume (cubic yards)	Length (feet)	Cost in 2003 Dollars
Vanderbilt	1983	Local/private	Renourishment	48,000	NA	$294,737
Naples/Gordon Pass	1986	Federal	Unknown	119,000	NA	$868,699
Marco Island	1989	State/local	Navigation	1,200,000	8,840	$7,723,816
Barefoot	1991	Federal	Navigation	NA	NA	NA
Wiggins State Park	1993	Federal	Navigation	35,000	NA	$114,252
Marco Island	1995	State/local	NA	2,400	NA	$13,637
Vanderbilt	1995	Federal	Navigation	42,000	NA	$138,166
Wiggins State Park	1995	Federal	Navigation	NA	NA	NA
Vanderbilt/Park Shore/Naples	1996	Federal	Storm Erosion	1,132,000	29,692	$11,994,662
Vanderbilt/Park Shore/Naples	2006	Federal, state, and local	Storm Erosion	673,000	NA	NA

NA= Data not available.
Source: Duke University, 2006.

2.6.2 Overview of Commercial and Recreational Fishing Activities in Collier County

2.6.2.1 Introduction to Commercial Fisheries in Collier County

Although there is no large commercial dock within the county, commercial fishing is a major component of the Collier County economy. The county produces about 3 percent of the state's commercial marine landings. A number of small ports serve as home to Collier County's commercial fleet, including Everglades City, Marco Island, Goodland, and Gordon Pass (Figure 12). Gordon Pass provides harboring for commercial boats out of Naples. The primary commercial targets are finfish (Spanish mackerel and shark) and crab. Shrimp fishermen fish out of Collier County waters and offload in neighboring Lee County, just north of Naples. Approximately 5 percent of the state's charter boats are located in Collier County.

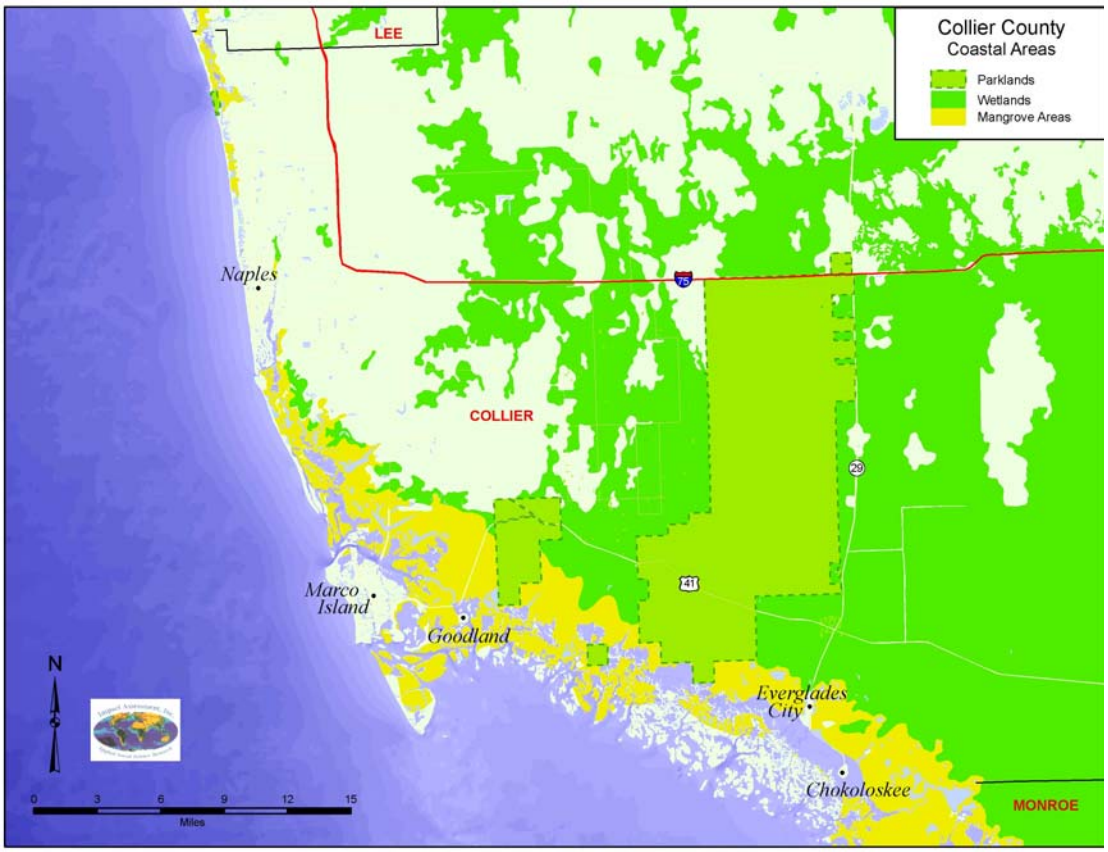


Figure 12. Collier County Fishing Ports (IAI, 2006).

Because Lee County fishermen share fishing grounds with Collier County fishermen in the state and federal waters off the Collier County coastline, commercial fishing data for Lee County is also presented here. There is little conflict between user-groups in this shared water space because Collier County fishermen predominantly target finfish and stone crabs, whereas the majority of Lee County fishermen are shrimpers–although they also target finfish and invertebrates. In Collier County, finfish and non-shrimp invertebrates accounted for all 1.8 million pounds of fish landed in 2005. In that same year, shrimp constituted the majority (59% or 4.9 million) of the 8.3 million pounds of seafood landed in Lee County. Lee County, alone, accounted for 26 percent of all shrimp landed in the State of Florida in 2005. Together, Collier and Lee Counties contributed 11 percent of the total invertebrate harvest and 6 percent of the total finfish harvest in Florida for that year (Tables 20 and 21).

Table 20

2005 Annual Landings Summary by Family Type: Collier County, Florida

Type of Fish	Collier County				State of Florida			
	Landings Pounds (lbs)	% Total Landings	No. of Trips	% Total Trips	Landings Pounds (lbs)	% Total Landings	No. of Trips	% Total Trips
Finfish	1,081,450	58.7	673	11.7	49,548,491	54.8	84,779	41.0
Invertebrates (non-shrimp)	758,943	41.3	5,121	88.3	20,303,019	22.4	96,480	46.6
Food Shrimp	0	0	0	0	18,944,684	20.9	10,166	4.9
Bait Shrimp	0	0	0	0	1,634,260	1.9	15,595	7.5
Grand Total	**1,840,393**	**100.0**	**5,794**	**100.0**	**90,430,454**	**100.0**	**207,020**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

Table 21

2005 Annual Landings Summary by Family Type: Lee County, Florida

Type of Fish	Lee County				State of Florida			
	Landings Pounds (lbs)	% Total Landings	No. of Trips	% Total Trips	Landings Pounds (lbs)	% Total Landings	No. of Trips	% Total Trips
Finfish	1,964,182	23.4	5,852	41.8	49,548,491	54.8	84,779	41.0
Invertebrates (non-shrimp)	1,424,910	17.0	6,150	43.2	20,303,019	22.4	96,480	46.6
Food Shrimp	4,916,623	58.7	1,156	8.1	18,944,684	20.9	10,166	4.9
Bait Shrimp	64,596	0.8	1,057	7.4	1,634,260	1.9	15,595	7.5
Grand Total	**8,370,311**	**100.0**	**14,215**	**100.0**	**90,430,454**	**100.0**	**207,020**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

2.6.2.2 The Crab Fishery

Both Collier and Lee Counties have very active crab fisheries. Relative to Lee County in terms of the total contribution it makes to annual landings, the Collier County crab fishery is particularly productive. In 2005, non-shrimp invertebrates–the vast majority of which were crabs– comprised roughly 42 percent of total landings for the county. Crabs also accounted for 97 percent of this invertebrate harvest, and 88 percent of all harvesting trips were for invertebrates (see Table 22).

Table 22

2005 Annual Invertebrate (non-shrimp) Landings Summary: Collier County

Invertebrates	Collier County				State of Florida			
Species	Landings Pounds (lbs)	% Total Invertebrate Landings	No. of Trips	% of Total Invertebrate Trips	Landings Pounds (lbs)	% of Total Invertebrate Landings	No. of Trips	% of Total Invertebrate Trips
Crab, Blue (hard)	119,872	15.8	325	6.2	11,501,262	66.5	38,892	47.3
Crab, Blue (soft)	1	>1	1	>1	100,788	0.6	2,187	2.6
Crab, Stone (claws)	620,109	81.6	4,876	92.9	2,283,513	13.2	24,202	29.4
Lobster, Spanish	238	>1	2	>1	9,132	>1	61	>1
Lobster, Spiny	18,655	2.4	29	0.6	3,376,817	19.5	16,697	20.3
Octopus	70	>1	15	0.3	14,166	>1	252	>1
Total Invertebrates	**758,945**	**100.0**	**5,248**	**100.0**	**17,285,678**	**100.0**	**82,291**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

In terms of overall economic contributions, Lee County's commercial fishing industry is more dependent on shrimp than on crab. Nevertheless, in terms of poundage, Lee County's crab fishery is very active. In 2005, Lee County fishermen landed 1.4 million pounds of non-shrimp invertebrates; crabs accounted for 99 percent of this harvest. Additionally, 12 percent of the state's blue crab harvest was landed in Lee County (Table 23).

Table 23

2005 Annual Invertebrate (non-shrimp) Landings Summary: Lee County

Invertebrates	Lee County				State of Florida			
Species	Landings in Pounds (lbs)	% of Total Invertebrate Landings	No. of Trips	% of Total Invertebrate Trips	Landings in Pounds (lbs)	% of Total Invertebrate Landings	No. of Trips	% of Total Invertebrate Trips
Crab, Blue (hard)	1,339,545	94.0	4,714	68.9	11,501,262	66.5	38,892	47.3
Crab, Blue (soft)	9,687	0.7	596	8.7	100,788	0.6	2,187	2.6
Crab, Stone (claws)	74,008	5.2	1,471	21.5	2,283,513	13.2	24,202	29.4
Lobster, Spanish	48	>1	2	>1	9,132	>1	61	>1
Lobster, Spiny	41	>1	3	>1	3,376,817	19.5	16,697	20.3
Octopus	1,582	>1	51	>1	14,166	>1	252	>1
Total Invertebrates	**1,424,911**	**100.0**	**6,837**	**100.0**	**17,285,678**	**100.0**	**82,291**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

The contribution made by Stone crabs landings to the Collier County seafood industry in substantial. In 2005, they accounted for 34 percent of the county's total seafood harvest and 82 percent of its total invertebrate (non-shrimp) harvest. Indeed, Collier County ranks second of all Florida counties in terms of its stone crab claw harvest. In that same year, Collier County produced 28 percent of Florida's total stone crab harvest; Lee County produced 3 percent (see Table 24).

Table 24

2005 Annual Stone Crab Landings Summary by County, Poundage, Number of Trips, Percentage of Florida's Total Landings, and State Rank in Poundage: Brevard, Collier, and Lee Counties

County	Landings In Pounds (lbs)	% of Total Stone Crab Landings	Trips	% of Total Trips	Percent of Florida's Total Stone Crab Landings	Rank in State in Poundage of Stone Crab
Brevard	1,240	0.1	94	1.4	>1	18
Collier	620,109	89.2	4,872	75.7	28.0	2
Lee	74,008	10.6	1,471	22.8	3.0	4
Total	**695,357**	**100.0**	**6,437**	**100.0**	**--**	**--**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

The stone crab harvest runs from mid-October until mid-May, and takes place from Sarasota to Fort Lauderdale. Once caught in traps, the crabs are harvested and one claw is removed. They are then returned to the water, where they will regenerate another claw in 18 to 24 months.

Unlike other forms of crabbing, stone crabbing is more labor-intensive because it requires frequent checking of traps and an on-site removal of claws. Pots are set on the bottom of shallow water and attached to buoys, which float on the surface and mark the trap. Each fisherman has his own markings on the buoys to identify ownership.

Crabbers also set a high volume of traps. On average, each crab fisherman sets 2,000 traps per season. The cost of one trap ranges from $20.00 to $50.00, but this price does not include the concrete to sink them nor the cost of bait, line, and buoys. Furthermore, setting crab traps is a labor-intensive endeavor; crabbers spend an average of two weeks placing them and another two weeks retrieving them.

However, the high prices paid for crab claws also can make it a worthwhile endeavor. In 2005, medium claws fetched $6.00 to $8.00 per pound; large claws went for $10.00 to $14.00 per pound; and "jumbos" sold for $14.00 to $17.00 per pound.

Distribution of Collier County Crab Fishermen. Crabbers from the Goodland area in Collier County typically work waters from the shoreline to approximately ten miles offshore. These waters are shallower and provide habitat to a key stone crab region (Figure 13).

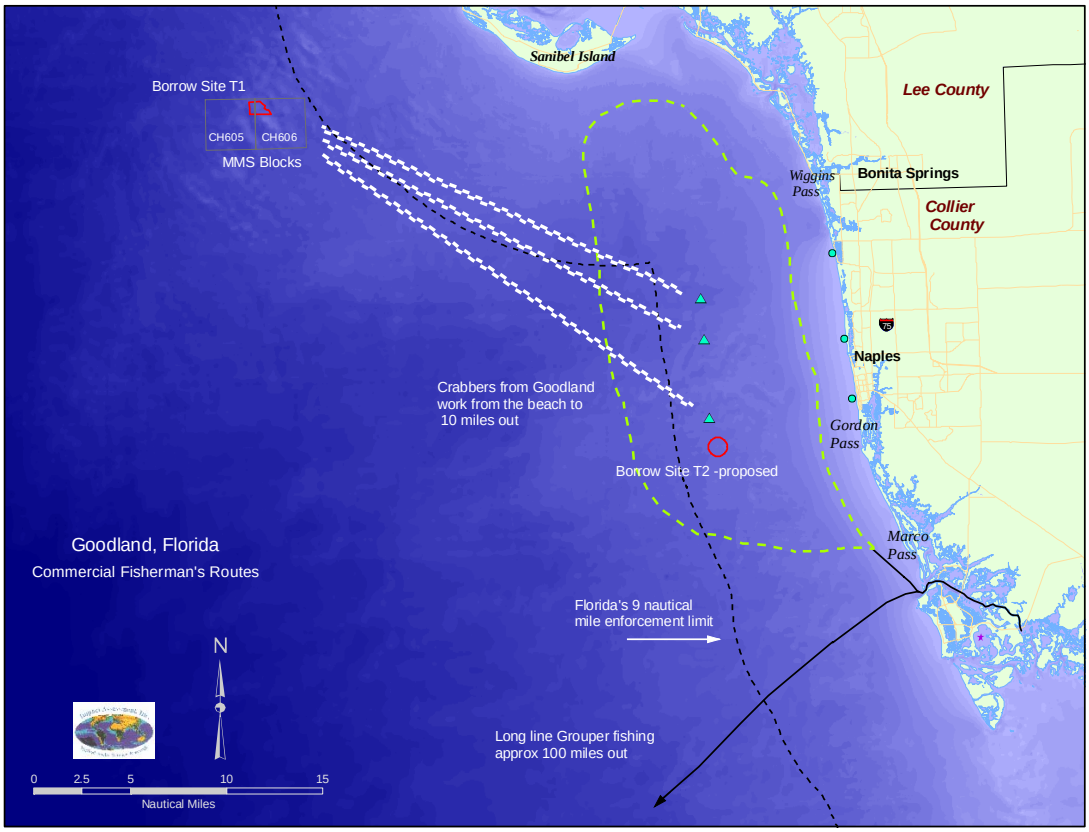


Figure 13. Goodland Crab Fisheries (IAI, 2006).

Crabbers from the Fort Myers and Gordon Pass areas set traps in a larger area than do fishermen in Goodland (Figure 14). These crabbers typically set as many as 3,000 to 4,000 traps in an area up to 20 miles off the coast. Traps are usually set on the rocky bottoms of the sea.

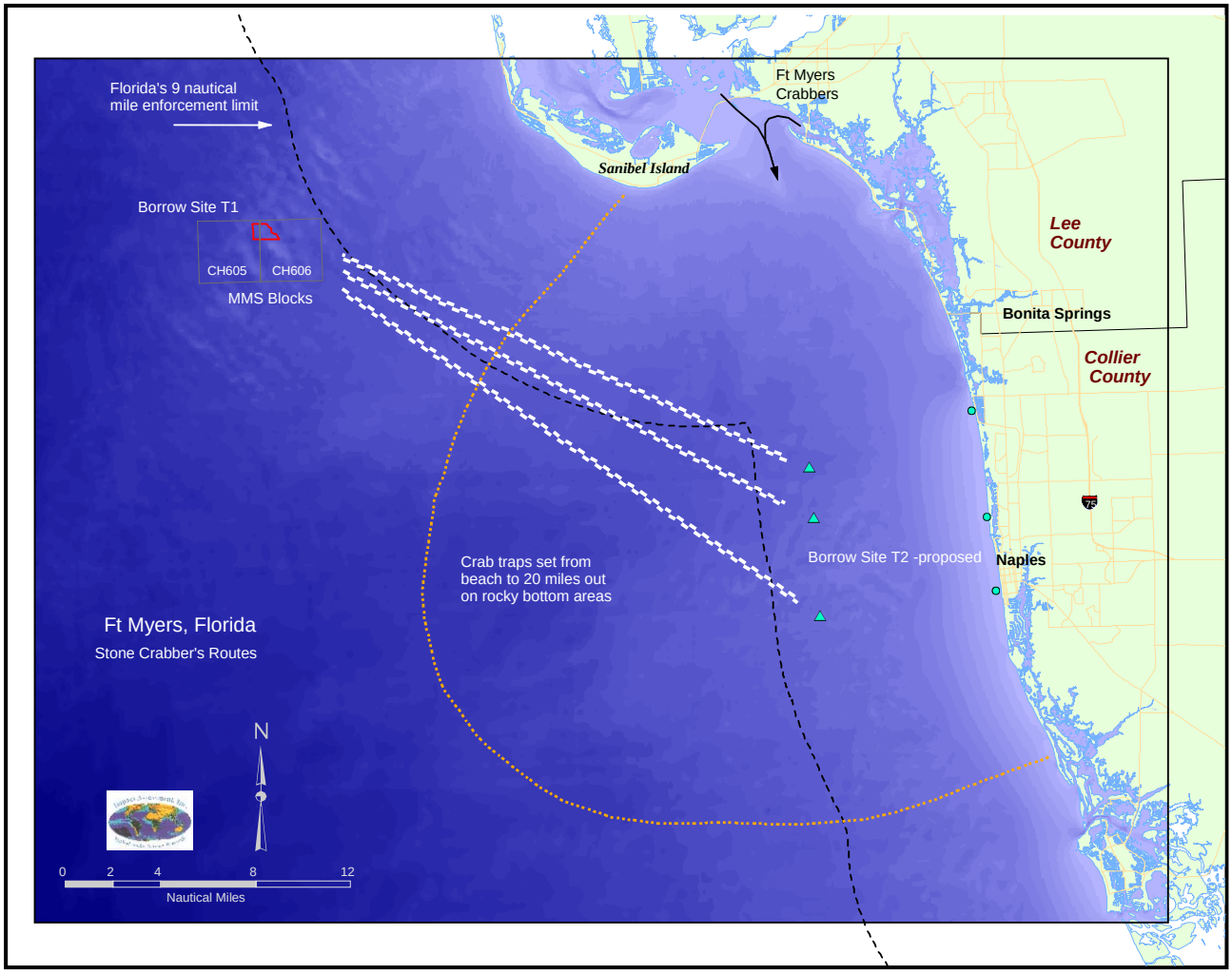


Figure 14. Fort Myers Crab Fisheries (IAI, 2006).

However, the waters in which crab fishermen from these three areas set their traps also contain the dredging pump-out station area. Therefore, dredging activities significantly concern Collier County crab fishermen.

2.6.2.3 The Finfish Fishery

Finfish constitute the largest fishery in Collier County. In 2005, one million pounds of finfish were landed in Collier County; 50 percent of this haul was red grouper Other significant finfish landings for that year included Spanish mackerel (14%), black mullet (10%), and shark (10%) (Table 25).

Table 25

Annual Finfish Landings (select) by Type of Fish Caught in Excess of 10,000 Pounds:
Collier County, Florida, 2005

Species	Landings in Pounds (lbs)	% of Total Finfish Landings	Number of Trips	% of Total Finfish Trips
Grouper, Black	31,783	3.0	101	12.8
Grouper, Gag	18,839	1.8	46	5.8
Grouper Red	523,967	49.8	178	22.6
Mackerel, King	150,135	14.3	101	12.8
Mackerel, Spanish	76,935	7.3	58	7.3
Mullet, Black	134,377	12.8	210	26.6
Pompano	12,363	1.2	53	6.7
Shark	103,986	9.9	41	5.2
Total Finfish	**1,052,385**	**100.0**	**788**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

Most finfish in Collier County are landed twenty miles or more offshore. Sanibel and Captiva Islands are among the primary finfish fishing grounds.

Lee County's finfish fishery is second only to its shrimp fishery. In 2005, finfish accounted for 23 percent of all seafood landings in Lee County. Black mullet contributed a significant majority (64%) of the total finfish landings in this county (Table 26).

Table 26

Annual Finfish Landings (select) by Type of Fish Caught in Excess of 10,000 Pounds:
Lee County, Florida, 2005

Species	Landings in Pounds (lbs)	% of Total Finfish Landings	Number of Trips	% of Total Finfish Trips
Grouper, Black	20,826	1.1	68	0.7
Grouper, Gag	71,568	3.8	184	1.9
Grouper Red	224,113	12.0	316	3.3
Grouper, Scamp	10,645	0.5	124	1.3
Grouper, Snowy	12,760	0.7	17	0.2
Jack, Crevalle	39,109	2.1	719	7.5
Jack, Mixed	32,788	1.7	293	3.0
Ladyfish	54,302	2.9	82	0.8
Mojohara	60,659	3.2	1,279	13.3
Mullet, Black	1,203,725	64.3	3,894	40.6
Pompano	95,384	5.1	563	5.9
Seatrout, Spotted	12,147	0.6	360	3.7
Sheepshead	32,979	1.8	1,691	17.6
Total Finfish	**1,871,005**	**100.0**	**9,590**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

2.6.2.4 The Shrimp Fishery

Although non-existent in Collier County, the shrimp industry is very economically important to Lee County (Table 27). San Carlos, Lee County's major shrimp port, is located just north of the Lee County/Collier County border. Between 150 and 200 shrimping vessels reportedly work in the vicinity of this port (Goddes, oral commun., 2006). In 2005, nearly 60 percent of all landings in Lee County were shrimp. In that year, shrimp landings amounted to 4.9 million pounds; these landings also represented 26 percent of all shrimp landings in the State of Florida (Florida Fish and Wildlife Conservation Commission, 2006).

Table 27

Annual Shrimp Landings: Lee County, 2005

Shrimp	Lee County				State of Florida			
Species	Landings in Pounds (lbs)	% of Total Shrimp Landings	Number of Trips	% of Total Shrimp Trips	Landings in Pounds (lbs)	% of Total Shrimp Landings	Number of Shrimp Trips	% of Total Trips
Shrimp, Brown	75,447	1.5	43	1.8	1,966,093	10.5	1,713	17.7
Shrimp, Pink	4,799,530	96.3	1,107	48.0	10,872,802	58.2	3,542	36.5
Shrimp, Rock	40,221	0.8	86	3.7	598,944	3.2	546	5.6
Shrimp, Other	1,426	>1	14	0.6	153,136	0.8	13	0.1
Shrimp, Bait	64,596	1.3	1,057	45.8	5,088,244	27.2	3,879	40.0
Total	**4,981,220**	**100.0**	**2,307**	**100.0**	**18,679,219**	**100.0**	**9,693**	**100.0**

Source: Florida Fish and Wildlife Conservation Commission, 2006.

Approximately one-third of the Lee County shrimp fleet harvests in waters roughly 20 miles offshore– in the same waters occupied by the 2006 Collier County beach nourishment dredge operation (Figure 15).

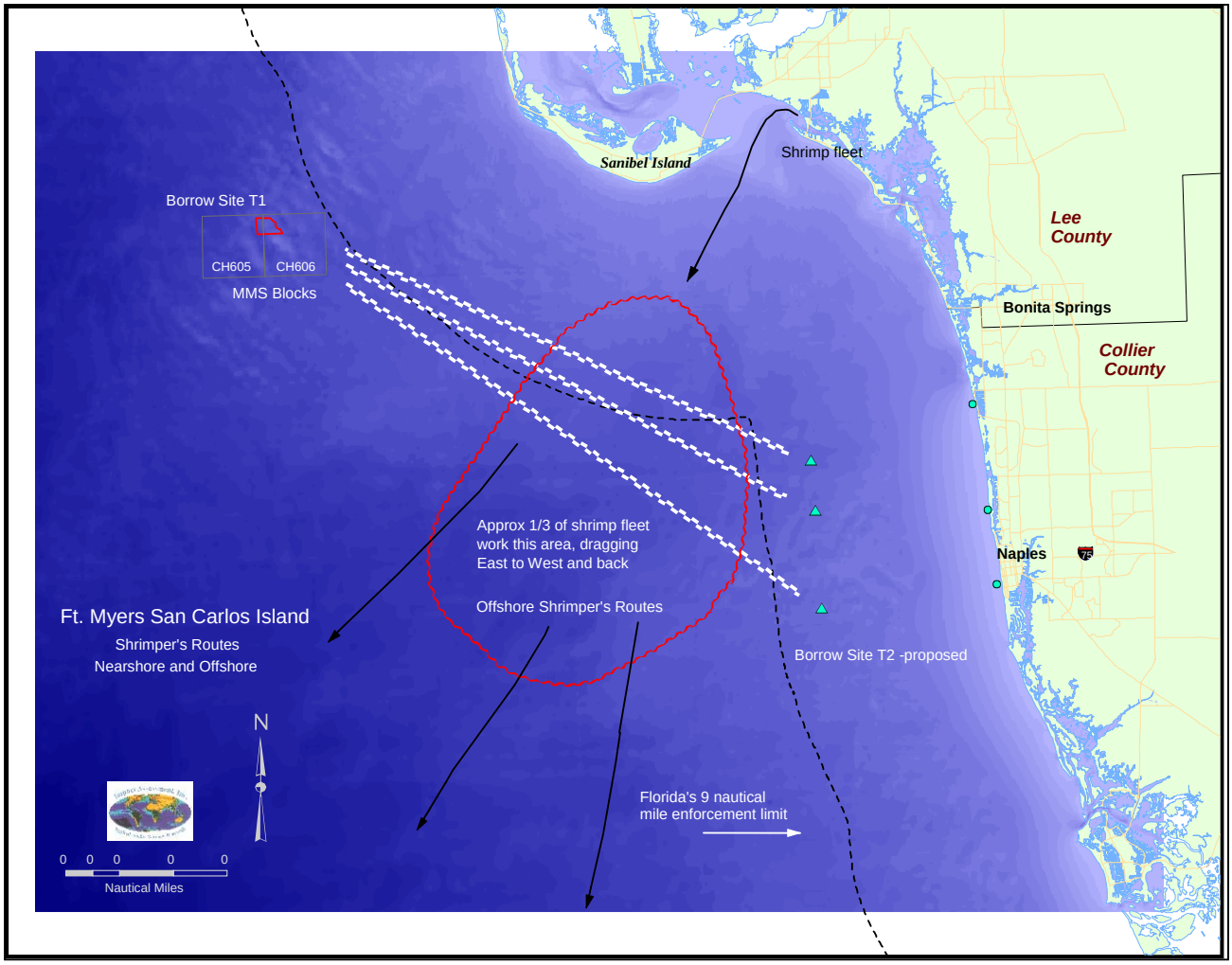


Figure 15. Shrimp Fisheries in San Carlos, Lee County, Florida (IAI, 2006).

San Carlos is also the major offloading and packing port for shrimp landed in both Collier and Lee Counties. Presently there are four offloaders/packers in Lee County: *Trico Shrimp Co., Gulf Shrimp Co., Villers Seafood and Marine Supply House and Seafood Packers*. There are also several support facilities that offer fuel, marine supplies, net repair, welding services and repair. Although old and in disrepair, the quarter to a half mile long docks provide dockage for over 150 vessels, many of which come from Texas.

Shrimping is a cost-intensive industry. Shrimp vessels burn an average of 20 gallons of diesel fuel an hour at roughly $2.40 a gallon for a 10 hour-night. Crew pay is a third of gross income, leaving captains with the remainder to pay loans, insurance, groceries, and other overhead costs. A $3,000 night is considered “very profitable,” $1,800 “average,” and $600 or less “very poor”. Nearly all the captains reported the 2006 season as “very good,” with the price for shrimp “the same as it has been since the 1970s–about $2.50 per pound for 26 to 30 count” (Goddes, oral commun., 2006). Offloaders also describe this season as successful, “It’s been a bumper season this year” (Goddes, oral commun., 2006).

Most shrimpers with whom we spoke agreed that the 2005-2006 shrimp season was about three times more profitable than normal. Typically, the boats bring in $3,000 to $5,000 a night; during the 2005-2006 season, however, these shrimpers averaged between $10,000 to $15,000 per night. One shrimper attributes this increase to the storms of the previous year and to the fishermen being on "the good side of a seven to eight year cycle" (Goddes, *Pers. Comm.*, 2006).

2.6.2.5 Introduction to Recreational Fisheries in Collier County

Collier County is home to a large charter fleet. This fleet harbors in a number of marinas located from Gordon Pass to the county's northern border. Tourism is a mainstay of the Naples area economy, with annual visitation approaching 750,000 people. As tourism increases so too does interest in the use of local waters for recreational purposes (NOAA, 2006).

Collier County is a popular tourist destination for recreational anglers. In the 1999-2000 fiscal year Collier County sold 22,297 non-resident recreational saltwater fishing licenses, which brought in $335,620 in county revenue. In that year, Collier County ranked third in the State of Florida in terms of revenue earned from non-resident anglers (Stephan and Adams, 2001).

The species most sought after by recreational anglers include: amberjack, barracuda, black drum, black grouper, cobia, flounder, gag grouper, jack crevalle, jewfish, king mackerel, ladyfish, lane snapper, mangrove snapper, mutton snapper, permit, pompano, redfish, red grouper, shark, sheephead; snook, Spanish mackerel, spotted trout, tarpon, tripletail, and yellow snapper.

Availability of each species varies by season. During April and May, for example, barracuda, cobia, jack crevalle, jewfish, mangrove snapper, pompano, redfish, red grouper, snook, Spanish mackerel, tarpon, and yellowtail snapper are the primary targets.

Charter fishermen generally navigate the waters off of Sanibel and Captiva Islands, off of Charlotte Harbor to the north of Naples, and the waters of Marco Island, Ten Thousand Islands, and Everglades National Park to the south of Naples. During the months of April and May, charter captains generally navigate waters outside the area designated for dredging. In the Fall, however, the area surrounding the Borrow Site T1 is a very popular fishing area for black grouper. Most charter captains find their best catch in waters 14 to 25 miles offshore – the same fishing grounds occupied by crab fishermen.

Recreational fishermen who venture out to sea with their own vessels generally stay in waters close to shore. Rarely do recreational fishermen travel beyond ten miles offshore, instead fishing in waters five to six miles offshore. Vessels are offloaded at many ramp sites, including North Fort Myers Beach, Big Carlos Pass, New Pass, Wiggins Pass, Gordon Pass, and Marco Pass (Figure 16).

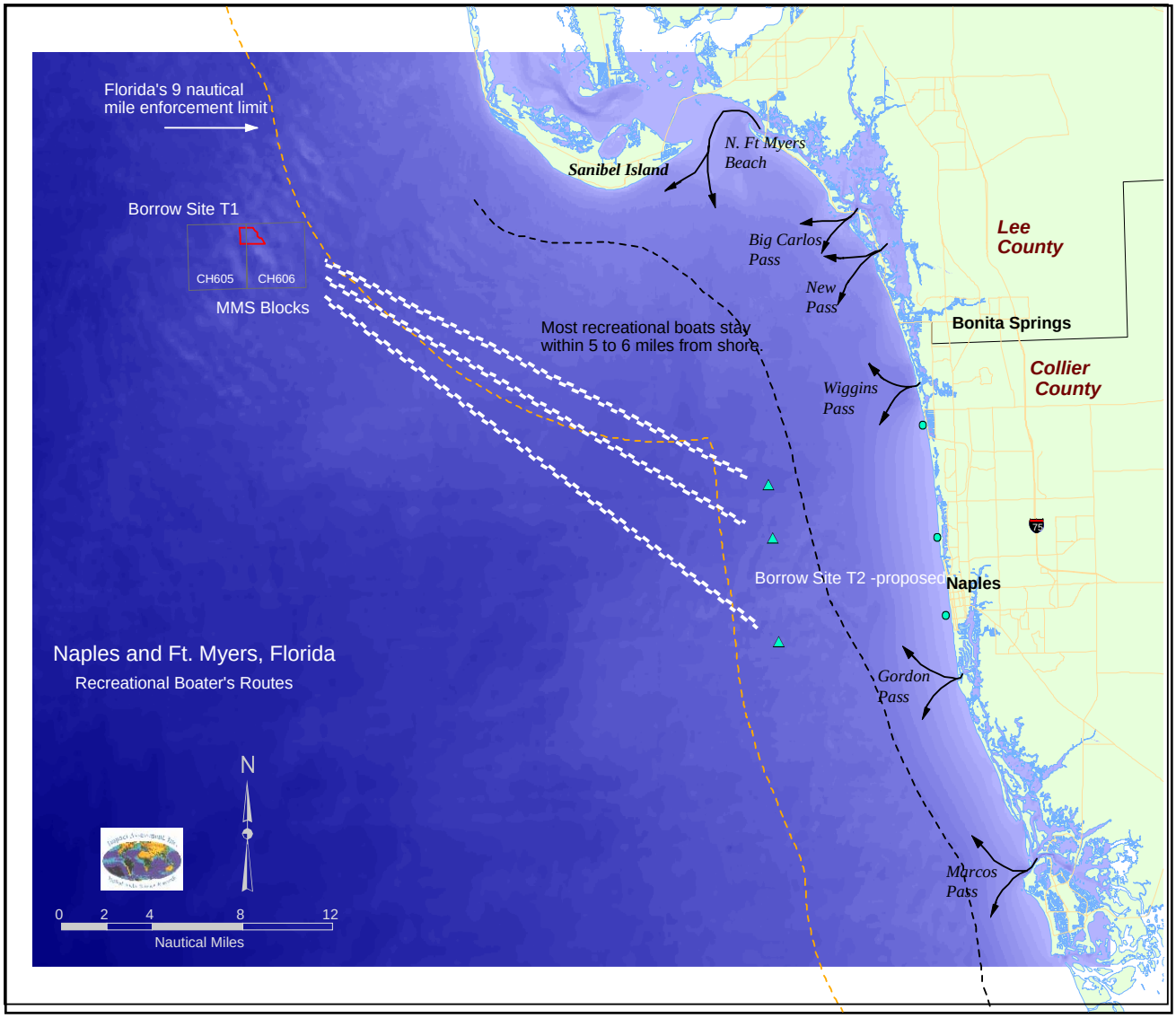


Figure 16. Recreational Fishing Area in Collier County (IAI, 2006).

2.6.3 Collier County Concerns about Sand Dredging Activities

2.6.3.1 Study Results

Identifying General Industry Concerns. The key industry-related concerns held by fishermen in Collier and Lee Counties were elicited during informal guided conversations. Their concerns ranged from general industry-wide trends to those specific to fishing in the Collier County area (see Table 28 below).

Table 28

Dredge-related Concerns Generally Shared by Industry Participants in Collier and Lee Counties

Dredge-related Concern	Commercial Fishermen	Charter Boat Fishermen	Recreational Fishermen
Increased vessel traffic	Yes	No	Yes
Disruption of fish habitat	No	Yes	Yes
Poor water clarity/quality	No	Yes	Yes

Source: IAI (field research), 2005-2006.

Overall, commercial and charter fishermen in Collier and Lee Counties are most concerned about the effects of sand mining operations off of Sanibel Island. By far, the two groups of commercial fishermen who expressed the most concern with dredging activities in this area are: (1) stone crab fishermen who fish immediately offshore Naples, North Naples, and Naples Park; and, (2) shrimp fishermen in Lee County, who must pass through offshore waters in Collier County. Tables 29 and 30 summarize their key concerns by type of fishing activity.

Table 29

Key Concerns with Sand Dredging in Collier and Lee Counties

Dredge-related Concerns	Crabbers	Shrimpers	Charter Operators	Recreational Anglers
Water Quality	No	No	Yes	No
Dredge Traffic	Yes	Yes	Yes	No
Dredge Equipment	Yes	No	No	No
Disrupts Fish Habitat	No	No	Yes	No
Interferes with communication space (VHF Radio Channels)	Yes	Yes	Sometimes	No

Source: IAI (field research), 2005-2006.

Table 30

Types of Conflict on Commercial Fisheries from Dredging Activities: Collier and Lee Counties

Type of Reported Impact/Conflict	Specific Impact/Conflict	Description
Direct Impacts on Commercial and Recreational Fishing Activity	Reduction in catches and landings	Participants claim a reduction in 2006 catch rates from loss of crab traps and curtailed shrimping activity.
	Exclusion from fishing grounds	Charter and commercial fishing operations have had to find alternative fishing sites during dredge operations.
	Economic impacts and increased operation costs	Lost/damaged equipment; lost fishing time.
Indirect Impacts on Commercial and Recreational Fishing Activity (via Ecological Impacts)	Potential damage to fish ecology	Fear that sand mining will affect black grouper spawning in the fall.
	Loss/damage to fish stocks	None.
	Water quality affecting fish	Water muddied around pumping stations causes fish to aggregate and creates better fishing.
	Physical changes to the seabed	None mentioned.
	Cumulative effects	Cumulative effects of dredging are as of yet unknown.

Source: IAI (field research), 2005-2006.

Conflict within the Stone Crab Fishery. As noted above, crab fishermen have very strong concerns about the impact of dredging operation on their livelihood. Their three primary complaints are: (1) loss of fishing equipment from dredge traffic; (2) poor communication by dredge operators regarding shifting day to day mining operations and navigation routes; (3) shared use of radio channels, thus resulting in static, interference, and delayed transmission of information.

(1) Loss of Crab Traps. The reported loss of crab traps from dredging operations is the most frequently mentioned source of conflict. Reports suggest that dredge traffic cuts the lines that attach the trap to the buoy. Once the lines are cut, traps are lost. One crab fisherman, who set traps from the 26.20 line to the 26.10 line, reported that he typically loses approximately 20 percent of his traps annually to storms, age, and other factors. In contrast, he has lost between 40 percent and 45 percent of his traps in the first half of 2006 alone during the dredging operation. This fisherman believes he has lost between 400 and 500 traps to the dredges. Another crab fisherman, who set 600 traps in one area, has only recovered 325 traps since the start of the recent dredging operation. A third crab fisherman reports setting 80 traps in one area, but was able to retrieve only 37 since the start of the dredge operation.

Other crab fishermen complain of a dredge drifting around the waters for hours, causing buoys to be torn up and lines cut. For example, one crabman shared, "[The dredge] sat about a mile off the beach and just drifted around for hours, tearing up every ones traps" (Goddes, oral commun., IAI, Naples, May 14, 2006). Another explained how he set many traps south of the pumping station, "where they are not supposed to be working". He also notes that the company sometimes left their tugs "drifting around there for hours. It just wiped out my traps while drifting" (Goddes, oral commun., 2006).

Crab fishermen believe the dredge operators are less than conscientious when it comes to careful treatment of their gear. They point out that industry protocol demands that divers be sent down to disengage tangled lines that become caught in propellers. However, when queried, one dredge worker explained that they do not customarily engage in such practices. Thus, it is likely that the spurs on the propellers of the dredgers are cutting away fishing lines and other debris. One crab fisherman reports that a dredge operator later confirmed this theory.

(2) Poor Communication. A second source of conflict for crab fishermen in the Naples area is poor communication by dredge operators regarding their navigation routes. One crab fisherman reports two dredges veering more than one hundred yards off their stated route. He believes that this "meandering" is not an accident. With the commonly employed "electronic captains" most vessels have onboard, he asserts, "Anyone can stay within a hundred yards or less from their course". Another crab fisherman offers a similar anecdote:

> The dredge company sent two men down to talk to me, and I did not believe there was a problem. They were nice guys, but said they stayed on a course line that never varied more than 100 yards. I didn't believe them. I followed them and plotted their course and it was off more than a mile. If they would stick to their course and tell us what it is, there would not be a problem. They never tell us when and where they are going to move the pumping station down the beach. The tugs pulling the pipe just tear the hell out of our traps; some pull a mile of pipe. If they would notify us, we would be happy to go move our traps (Goddes, oral commun., 2006).

In an effort to avoid further losses, some crab fishermen have contacted dredge captains requesting coordinates for the course. One fisherman, determined to locate a course, contacted the Naples Mayor, followed by Naples City Department of Natural Resources, after which he was provided with a course. Following the information provided by these county officials he set his traps a half mile away from the dredge line; nevertheless, hundreds of traps were lost. He reports,

> I know it was the dredge because I would go out to check my traps and, after a few buoys, I would find a buoy with red bottom paint rubbed along one side, then many missing buoys and then a another buoy with red bottom paint on it where the dredge left that line. It almost seemed like they were weaving in and out of my traps (Goddes, oral commun., 2006).

The majority of crab fishermen stated that they would be more than willing to move their traps out of the dredgers' path, if only they were apprised of the day-to-day course of the dredgers. One states, "The season is only five months long, but I would still gladly go move them instead of losing them" (Goddes, oral commun., 2006).

He wonders further:

> Why can't they just tell us when they are going to move and where…what course they are going to use and stick to it. We are willing to work with them and stay out of their way. I will keep my traps a half mile away from their course. I will go out and move my traps when they move down the beach if they would just tell me (Goddes, oral commun., 2006).

The lack of communication by dredge operators with crab fishermen critically impacts their fishery participation. However, when crab fishermen contact the dredge operators, they are often told that their activities were on "a need to know basis" and that they "did not need to know". One crabman reports, "Some days you can reach them on the radio and get information, and other days they never answer" (Goddes, oral commun., 2006).

Although the county provided notice of the dredging project in the county newspaper and held weekly public forums, many crab fishermen contend that they were unaware of such notices and meetings. This discrepancy suggests that crab fishermen access industry information through different channels than the general public. These fishermen acknowledged, however, that dredge workers did come to the docks to explain the pending operation and seemed to show concern for their fishing operations. However, according to a crabman, "Once out on the water, it never seemed to work [the way they said]". One crabman who set his course on his onboard computer and relocated his traps based on information he received in the early days of the operation from a project official, concurs that while this effort was made early on, "it went down hill fast" (Goddes, oral commun., 2006).

(3) Shared Communication Channels. The third major source of conflict stems from the use, or misuse, of shared communication channels. Crab fishermen in this area typically use Very High Frequency (VHF) Radio Channels 7 or 8 to talk– two channels that the dredge company soon began to usurp. Initially, the dredging company only used Channel 8, but when this proved insufficient for the company's communication needs, they began accessing Channel 7 as well. Such shared use results in difficulty for crabbers and offloaders in communicating with each other, as the dredges have more powerful radio equipment and emits stronger waves. Moreover, the frequent and ongoing communication between dredge workers often consumed all air space. Crab fishermen maintain that there are many other unused channels that the company could have used to meet their communication needs instead of the only two commonly used by the fishermen.

Communication between fishermen is vital. As underscored by the U.S. Department of Labor, Bureau of Labor Statistics (2006), "Navigation and communication are essential for safety of all of those who work on the water, but particularly for those who work far from shore. Malfunctioning navigation or communication equipment may lead to collisions with underwater hazards or other vessels and even shipwrecks". In Collier County, the loss of communication has not yet resulted in any serious consequences; nevertheless the inconvenience it posed was a major source of tension.

While the grievances crab fishermen harbor against the dredge operations have now escalated to the point where they may file a lawsuit to recoup their losses, county officials and dredge operators appear not to be aware of such conflict. In fact, during the final public project weekly meeting attended by Collier County government, local residents, and dredge operators, the subject of fishermen conflict was never mentioned. However, when the potential for conflict was at long last broached, one dredge captain jokingly noted, "Our boats are bigger so everyone gets out of the way".

Conflict within the Shrimp Fisheries. Shrimpers also express concern about the impacts of dredging on their livelihood. However, roughly 70 percent of the San Carlos, Lee County shrimp fleet works from up to 200 miles north of San Carlos Bay all the way down to Key West. These fishermen access the Gulf from San Carlos via the Estero Pass into San Carlos Bay. The shrimp fleet then navigates past the south end of Sanibel Island. This portion of the fleet reported no difficulty crossing the dredge path as they only cross it when they leave and enter the port. Furthermore, because they are not pulling their nets in this area, they enjoy great maneuverability.

The remaining 30 percent of the fleet, however, comes into regular and direct contact with the dredge vessels. This portion of the fleet shrimps from roughly 14 to 30 miles offshore between the 100 line and the 890 line. These boats pull their nets on an east-northeast to west-southwest path and back, moving diagonally across the dredge path, with crosses northwest to southeast and back. Pulling nets all the while, their maneuverability is significantly decreased. The average speed for pulling nets is only 2.6 to 2.8 knots. Further, it is difficult to gain speed if a vessel is required to move rapidly away from another vessel. In such situations, the vessel must stop or turn 180 degrees and pull back out. In this latter situation, a shrimper will miss a large bottom area, costing him catch and, consequently, income.

Shrimpers also cite lack of communication as a major problem for them as it results in contested user space. For example, many shrimpers complained of the variation in the dredge course at night, requiring shrimpers to stop or turn around while pulling their nets. One shrimp boat captain explained what happened when a dredge captain requested the shrimp captain to cross his bow: "I replied, I can't; I am only moving 2.8 knots". The dredge captain said, "Then stop or I will run you down". "I stopped but lost a lot of my catch and was very upset" (Goddes, oral commun., 2006). Another shrimper relayed a similar experience:

> [The dredge captain] comes up fast on you and points his light on you. When I raise him on the radio and ask him to slow or change course, he says, "There are too many of you; I am not slowing down or changing course. Either stop, move or I will run you down". We have to work together. We have been working here for 30 years, he hasn't. One night I called the dredge when I saw him coming and the reply was "Cross my bow". I replied, "I can't. I am only going 2.6 knots. The dredge replied, "Well then tough luck" and kept coming. He said I had to stop or get run down. We have to work together. We have been here longer then they have.

Charter Boats. Charter boat captains were more concerned with rising fuel prices, diminished water quality, dying reefs, and red tides than they were with local sand-mining operations. Those who considered the impacts of dredging were concerned with whether operations at the borrow site were interfering with the juvenile black grouper habitat. These captains reported that the area identified as "T-1" is a spawning area for black grouper in the fall, a lucrative time of the year for many charter fishermen. However, these charter fishermen also believe it is too early to definitively know the effects of dredging on this habitat, "I don't know if this will help the fishing or hurt it. I guess we'll find out this fall" (Goddes, oral commun., 2006).

When asked about the beach project and potential disruption of traffic, most charter captains explained that they fish in areas that are fairly distant from the dredges. Many captains navigate directly out Gordon Pass, turning north or south 10 to 15 miles offshore to fish for grouper, snapper, king fish and cobia. Rarely did charter fishermen go far beyond Gordon Pass and, during the months that dredging took place, rarely did they travel north, making sure to stay clear of the beach project. One fisherman explains, "I go out south of where they are working and do not turn north till I am much further out; further than the pumping stations. I never go very far north because I only do half-day charters". Another states that he does not go near the dredging project, "I give them a wide berth because of all the bad things I've heard about them" (Goddes, oral commun., 2006).

When asked about communication issues, one charter fisherman indicated that he was aware of the problems the crab fishermen were having with the dredgers using their channels, but did not understand the root of the problem,

> I hear all their problems and don't understand why it's happening. These crabbers are good guys willing to move their traps if they knew when and where. I've worked on the water up and down the east coast and have never seen such a problem. It's good to rebuild the beach; it looks beautiful and will help tourism. I just wish it could be done with fewer problems for the crabbers (Goddes, oral commun., 2006).

Other complaints concern the lack of advance notice they are given about the dredge operations. One charter boat operator offered the following critique, "They don't give adequate notice. And what they do give is very confusing". He continued, "I heard one boater call the on his radio to ask them where the pipe was, but the reply was so confusing, I had no idea where they were talking about. I have no idea what ever happened to that boater but was glad it was not me". His mate confirmed this report, "They gave very poor instructions. I just crossed my fingers and made it". They both asserted the need for clearer and earlier notification regarding dredge operations so they could make the necessary adaptations.

Recreational Boaters. The majority of recreational boaters who offered their opinions for this study generally were unaware of the beach renourishment project, despite the fact that public notices have been posted in Collier County newspapers. Those who were aware of the project stated they had little or no problem with it. Some even reported that the "stirred up waters" had improved fishing conditions in waters surrounding the pump-off stations and that "cobia fishing was excellent".

Only one recreational fisherman had an issue with the dredge project. He felt that the borrow site should be "the passes" rather than the shoals because "that is where all the sand from the beaches went to" (Goddes, oral commun., 2006).

Other Stakeholders' Issues. The two sightseeing operations working from Naples do not report having any issues with the dredging project. They have adjusted their routes to stay clear of the project area. Beachgoers and water-front homeowners additionally report being very impressed with the beach renourishment project. They point to the improved quality of beach sand, and to a more pleasant beach experience, overall. One beachgoer notes that the higher and wider beach makes it seem less crowded.

2.7 Intra-State Comparisons

Similarities between sand-mining operations across the State of Florida include standardized and specific regulations regarding when and where such operations may occur. In both Brevard and Collier Counties, local government officials were required to follow the same procedures for filing for an application to restore their beaches. As previously outlined, both counties were required to apply to USACE, MMS, and FDEP, submitting studies on the area and requests for permits. Also, in both cases, mining took place in the spring of the year during the tail end of crab season and the beginning of shrimp season.

Importantly, the location of the sand borrow site can fuel conflict between area fishermen and dredge operators. For example, Brevard County's borrow site is located in Canaveral Shoals, a federally restricted "non-fishing" zone. With little or no competition for water space, the potential for conflict between area fishermen and dredge operators in Canaveral Shoals is minimal. The Brevard County crab fishery lies predominantly in the back bays and lagoons and is therefore undisturbed by offshore sand-mining operations. In contrast, the Collier County borrow site is located in an active fishing area. Consequently, dredge operations here are a source of contention for many commercial fishermen whose livelihood is at times directly impacted by extraction activities. For example, crab and shrimp fishermen in the Naples area of Collier County both lost access to traditional harvesting grounds. Crab fishermen also lost gear. When borrowing sites and fishing areas overlap, fishermen–not dredge operators–lose access to their grounds.

Fishermen can also suffer economic losses when the sand borrow site is located in an active fishing area. The offshore location of the Collier County borrow site created real economic stress for crab fishermen who claim that less than conscientious dredge operators significantly damaged or destroyed their crab pots. In Brevard County, however, the dredge operations created only the potential for economic stress, with some fishermen expressing mild concern about increased fuel costs stemming from temporary closure of their navigational shortcut across the Shoals.

The location of the sand borrow site relative to the renourishment site can also be a source of conflict. For example, in Collier County, the dredge operation was located 33 miles from the renourishment site. This distance necessitated accommodations and equipment unnecessary when the borrow site and the renourishment site are in closer proximity. The Collier County's offshore operation thus required more vessels, such as scows and tugs, to move materials from the borrow site to the pump-out stations, and in the movement of pipes up and down the beach. Increasing vessel traffic intensifies the potential for conflict between users of the same navigational space. In contrast, only three pump-out stations were located two to three miles offshore in 25 feet of water at the Canaveral Shoals borrow site. Pipes ran from the pump-out station to the beach, and were moved to different pump-out stations at various stages in the renourishment process. This operation was much less disruptive to fishing activities in this area.

Regardless of location, fishermen at both sand borrow sites were concerned with the potential of dredge operations to disturb the seabed and disrupt juvenile fish habitats. In Brevard County, the central concern was that dredging on the Shoals might silt the reefs and diminish an important food source for many young fish. Similarly, Collier County charter boat fishermen expressed concern that dredging operations at Borrow Site T-1, a known spawning ground for black grouper, would interfere with the available fish stock. Black grouper is a favorite target of sport fishermen.

Table 31 summarizes the key similarities and differences between sand mining operations at both case study sites in 2005.

Table 31

Key Similarities and Differences between Sand Mining Operations
in Brevard County and Collier County

KEY SIMILARITIES		
Type of Reported Similarity		**Relevance**
Regulations		Both counties must abide by the same rules and regulations that govern all Florida state and U.S. dredging projects.
Season of Dredge Operation		Both occurred in Spring, at the onset of turtle nesting season, the beginning of shrimp season, and the end of crab season.
KEY DIFFERENCES		
Type of Reported Difference		**Relevance**
Active military port and space shuttle launch zone versus non-port area.		Canaveral Shoals is not a fishing area and lies within a federally restricted military zone, thus minimizing both direct/indirect impact and conflict between user-groups.
No fisheries versus predominant crab fisheries in immediate dredge traffic area.		The dredge traffic zone off of Cape Canaveral/Cocoa Beach did not interfere with any fisheries; the white shrimp fishery was able to trawl further south. However, the dredge traffic zone off of Naples/Vanderbilt Beach interfered greatly with the crab fisheries.
Distance of borrow site from beach renourishment site.		The greater the distance the more equipment required by the dredge company to move scows and pipeline and, consequently, the amount of dredge-related traffic.
Direct Impacts of Dredging on Fisheries	Exclusion from/increased competition for fishing grounds.	Some increased competition for space or loss of access to fishing grounds in Naples, particularly with regard to the crab, and sometimes shrimp, fisheries.
	Economic impacts.	Loss of gear in Collier County. Potential for increased fuel costs in Brevard County.
Indirect Impacts of Dredging on Fisheries	Damage to fish ecology: breeding, spawning, and feeding.	In Brevard County, “silting the reef” and loss of food supply for reef fish is of primary concern. In Collier County, dredging may disrupt black grouper spawning grounds.
	Physical changes to the seabed.	Changes to seabed in Brevard County may alter currents, which in turn may prevent break-up of heavy seas.

Source: IAI (unpublished field research), 2005-2006.

3.0 U.K. SURVEY OF DREDGING IMPACTS

3.1 Introduction

This section of the report is intended to provide information on marine aggregate extraction both within U.K. waters and, more specifically, on the Hastings Shingle Bank (HSB), located off the Sussex coast of South East England. The information presented within this report has been obtained through an extensive desk-based review and discussions with individuals and groups associated with marine dredging on both a national and site-specific level.

The report contains information on the following areas:

General Information

- The historical background for offshore aggregate (sand and gravel) extraction in the U.K.;
- An overview of the current U.K. marine aggregates industry;
- An overview of the current U.K. commercial (and recreational) fisheries industry;
- Comparison between the two industries;
- Spatial distribution of marine aggregate extraction in U.K. waters;
- Spatial distribution of commercial fishing activity in U.K. waters;
- The U.K. regulatory environment for marine aggregate extraction.

Information about the Hastings Shingle Bank

- The Hastings Shingle Bank (HSB);
- History of marine aggregate extraction on the HSB;
- History of commercial fishing activity on the HSB;
- Main conflicts between aggregate extraction and commercial fisheries on HSB;
- Existing mitigation measures;
- Future conflict and potential mitigation;
- Conclusions.

3.2 An Overview of the U.K. Marine Aggregates Industry

Sand and gravel dredging in the U.K. has its origins in the supply of material for the ballasting of sailing ships to increase their stability and handling at sea. There are records of dredging on the Thames in the 1550s and, by the 17th and 18th centuries, the provision of ballast from marine dredged material was an important activity. The pattern of use started to change in the early part of the 20th century as the construction industry began to use marine aggregate. This market grew rapidly, especially during the boom in construction in South East England in the late 1960s and early 1970s. Today, in the 21st century, the main use of marine aggregate is in ready mixed concrete and concrete products.

The total contribution of marine aggregate to U.K. supplies between 1955 and 2002 has been around 500 million tons, and marine aggregate makes up around 21 percent of the current production in England and Wales. Most marine aggregate is used by the domestic construction industry or is exported but a component is also used for beach renourishment and contract fill. Around 20 million tons was used in this way in the 1990s.

Up until the 1970s there was some resistance to the use of marine aggregate because of concerns about the quality of the material and its long-term viability in construction materials. In practice, there are very few differences between materials found in either freshwater or saltwater locations as the sands and gravels quarried from inland river valleys commonly have the same origin and were deposited by the same processes as the material dredged from the seabed. They are, therefore, used for similar applications, primarily as a constituent of concrete and for general construction uses. Marine aggregate does tend to have a higher chloride content and more shell material but it meets the same British and European standard as aggregate from land. High profile construction projects in the U.K. which have used marine aggregate include the Channel Tunnel Rail Link, Canary Wharf development, the Gateshead Millennium Bridge and the Cardiff Bay Barrage. Similar proportions of marine and land-won sand and gravel are used for concreting purposes (around 65 percent of total production).

The mining of marine-dredged sand and gravel from the U.K.'s seabed is an important element in the supply of construction aggregates and the construction of beach defences. For the greater part of the last century, this contribution was relatively modest (up to seven million tons). However, due to advances in the ability to efficiently extract resources of a higher quality and consistency, production of marine aggregates more than doubled during the 1970s. Since 1955, a total of around 500 million tons of aggregates have been dredged from the sea (British Marine Aggregates Producers Association [BMAPA], No date).

At current rates, the extraction of sand and gravel extracted from the seabed around the U.K. constitutes some 15 percent of the total national demand for sand and gravel in Great Britain (Table 32). Of the total extraction figure of 22,226,070 in 2003, 6.1 million tons (27% of the total) was exported to ports in Holland (approximately 58%), Belgium (29%), and France (13%) (Crown Estate, 2004).

In addition to dredging for aggregate end-uses, significant marine dredged material is used as fill in coastal construction works, and for beach renourishment schemes. The consumption figures for these projects show significant annual fluctuations, reflecting the phasing of major contracts. Between 1988 and 2003, the quantities dredged for contract fill and beach nourishment projects has varied between 3.8 million tons (1988), 7.2 million tons (1996), 1.6 million tons (2001) and 2.1 million tons (2003) (Crown Estate, 2004).

Table 32

U.K Marine Aggregates Industry – Key Facts

- 21 percent of the sand and gravel needs of England and Wales comes from marine aggregates;
- 33 percent of South East England's (including London) sand and gravel needs come from marine aggregates;
- 90 percent of the sand needed in South Wales comes from marine aggregates;
- The industry supports approximately 2,500 full-time jobs;
- The industry operates more than 25 British-registered vessels that land their material at more than 70 wharves around the U.K.;
- There are 12 dedicated marine aggregate companies operating in U.K. waters;
- Nine of these companies promote some of their work jointly through a trade association known as the British Marine Aggregates Producers Association (BMAPA);
- Approximately 54 percent of all marine aggregates are supplied to the U.K. construction market;
- 18 percent is used for beach fill and nourishment projects;
- 28 percent is exported to other European countries;
- According to the Department for Environment, Food and Rural Affairs (DEFRA), the marine aggregates industry had a £132 million ($261 million U.S. dollars) per year gross output in 2003;
- The industry also provided an added value of £68.6 million ($136 million).

Source: BMAPA, No date.

Over the past one hundred years, marine aggregate extraction in U.K. waters has changed from a small-scale activity that involved the extraction of a few million tons per annum, to a major industry which, in 2005, directly employed over 2,500 people and extracted over 20 million tons of aggregate**.** Currently, around 20-25 million tons of marine aggregates (sand and gravel) are extracted each year from 72 licensed areas in U.K. waters. These areas are licensed by the Crown Estate, under advice from the Department for Communities and Local Government in England (DCLG, formerly ODPM), the Welsh Assembly Government in Wales and the Scottish Office in Scotland. The quantity of marine aggregates landed in the U.K. between 1982 and 2000 is shown below in Figure 17.

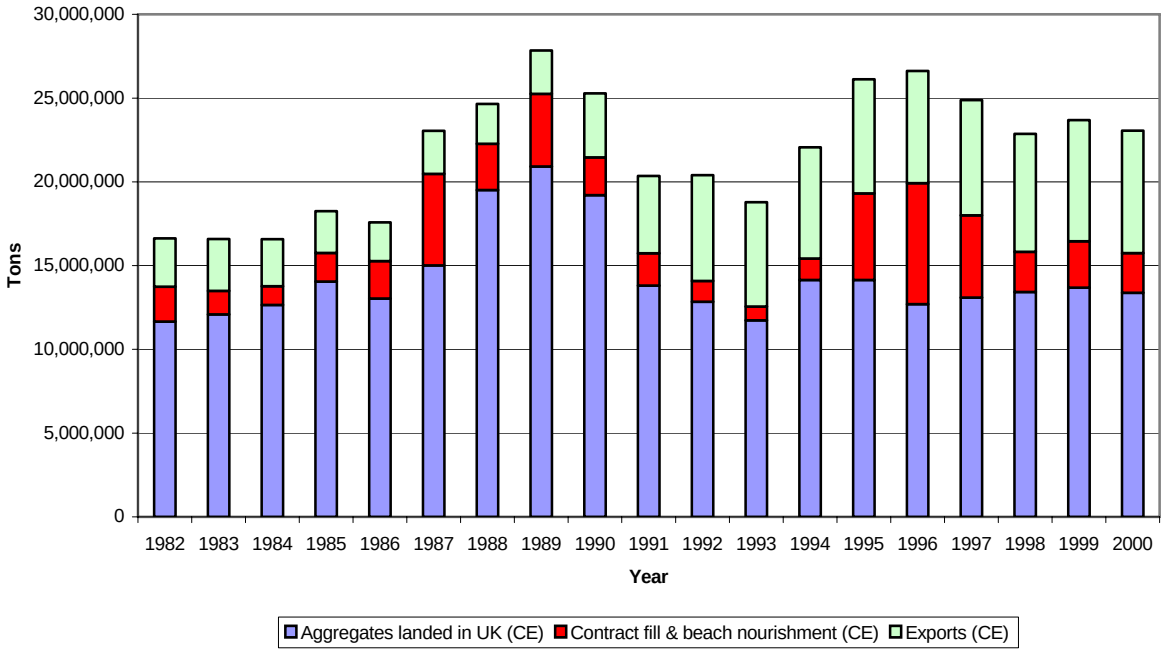


Figure 17. U.K. marine aggregate production 1982-2000 (Posford Haskoning, 2002).

The most recent figures for the amount of marine aggregate extracted from U.K. waters are presented in the 8th Annual Report produced by BMAPA (Table 32). The data on the area of the dredge operation has been obtained from the Electronic Monitoring Systems (EMS) fitted to all U.K. dredgers.

Table 33

Summary Statistics for 2005

Region	Total Area Licensed (km2) during 2005	Total Active Dredge Area (km2) for 2005	Total Area Dredged (km2) during 2005
Humber	483.68	146.70	31.17
East Coast	268.00	182.96	52.48
Thames	102.87	96.36	12.30
South Coast	215.45	100.37	29.35
South West	54.41	49.55	10.24
North West	54.95	19.96	2.01
Total *	**1179.36**	**595.90**	**137.55**

* Total area actually available to be dredged during 2005, calculated on a cumulative basis
Source: BMAPA, 2005.

With respect to actual operational techniques, the main form of dredging undertaken in U.K. waters is trailer dredging using Trailing Suction Hopper Dredgers (TSHD). During trailer dredging the TSHD lowers one or two suction pipes and trails them across the seabed at slow speeds (3 knots). At the end of the suction pipe a "draghead" is in contact with the seabed. The majority of U.K. vessels use a "California" style draghead. The draghead can be raised or lowered from the seabed to alter the density of the pumped mixture. The draghead may also be lifted clear of the seabed to avoid obstacles or known "resource-poor" patches. The loading pipes may be fitted with dump valves that allow the pumped mixture to be instantly dumped overboard, before entering the hopper, should it be clear that the mixture is contaminated with clays or silts.

The other form of dredging is static or anchor dredging, where the vessel lies at anchor whilst operating. Static dredging is used by dredgers for aggregate extraction within the U.K. where the resource represents more localized, terrace deposits or channel in-fills (BMAPA, No date). During these operations, the dredged aggregate is retained directly into the hopper.

3.3 An Overview of the Current U.K. Commercial and Recreational Fishing Industries

3.3.1 U.K. Commercial Fishing Industry

The most recent information on the U.K. fishing industry is that which is presented in the U.K. Fisheries Statistics Report for 2005 (published by the newly formed U.K. Marine Fisheries Agency). The following overview is largely based on the findings of this recent report.

In 2005 the fishing industry in the U.K. had 6,341 fishing vessels, with a further 381 vessels registered in the Channel Islands and the Isle of Man. Some 708 thousand tons of sea fish were landed in the U.K. and abroad by the U.K. fleet with a total value of £571 million ($1.1 billion). In addition the U.K. imported some £1,686 million ($ 3.271 billion) worth of fish. The U.K. also exported fish and fish products to the value of £925 million ($1.8 billion) (Table 34).

The U.K. has a substantial fish processing industry of around 573 businesses, which employ some 18,180 people.

The main fishing ports of the U.K. are shown in Figure 18.

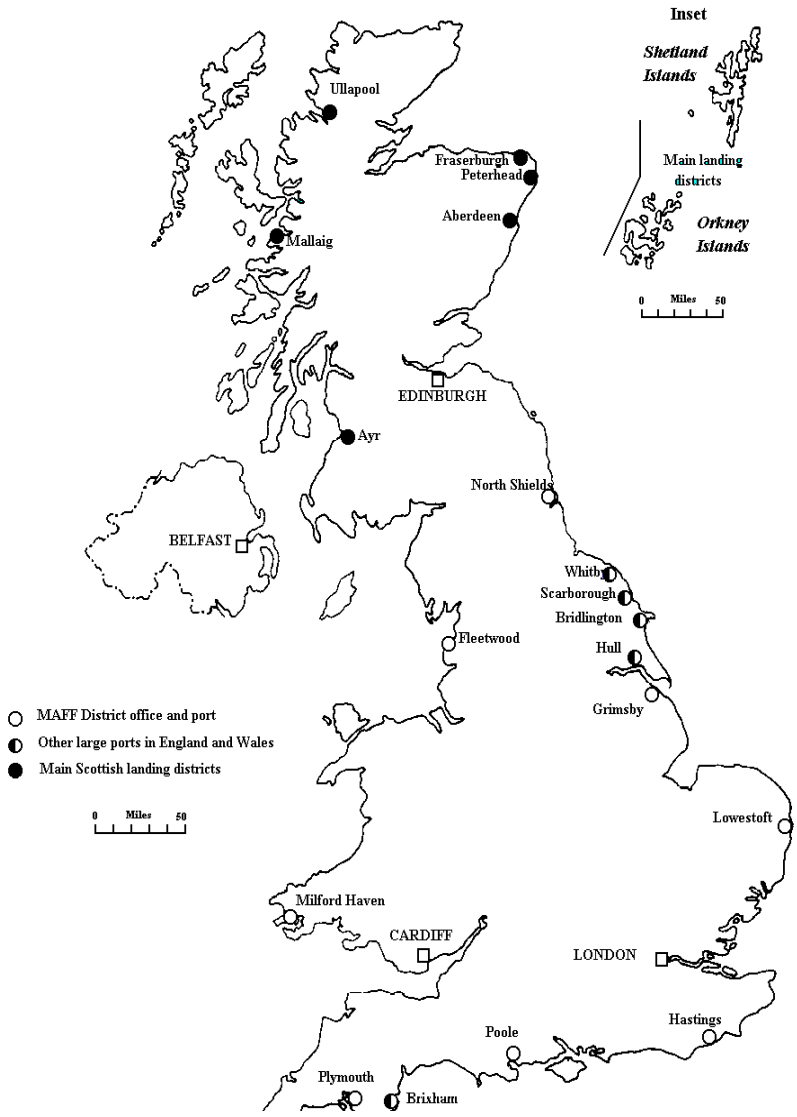


Figure 18. Main U.K. Fishing Ports (United Kingdom Sea Fisheries Statistics, 2005).

Table 34

U.K. Commercial Fishing Industry – Key Facts

- The U.K. supports a diverse and well-established commercial fishing industry.
- Vessels are based in ports all around the U.K., ranging from major fishing ports such as Peterhead in Scotland to small ports supporting only two-three vessels and landing small amounts of fish.
- In 2005, 708,000 tons of sea fish were landed into the U.K. and abroad by the U.K. fleet with a total value of £571 million ($1.1 billion).
- The U.K. also exported fish and fish products to the value of £925 million ($1.8 billion).
- The U.K. also has a substantial fish processing industry of around 573 businesses, which employ some 18,180 people.
- A wide range of species are targeted by the U.K. fleet and these can be broadly grouped into demersal fish, pelagic fish and shellfish. In 2005, in terms of quantity of total landings, demersal species represented 32 percent, pelagic species 43 percent and shellfish 25 percent (Figure 19).
- The majority of U.K. landings are made into Scottish ports.
- 77 percent are <10 meters (33 feet) in length.
- Vessel numbers have decreased from 9,720 in 1994 to 6,715 in 2005.
- Numbers of full-time fishermen in the U.K. have fallen from 11,023 in 2004 to 10,353 in 2005.

Source: United Kingdom Fisheries Statistics, 2005.

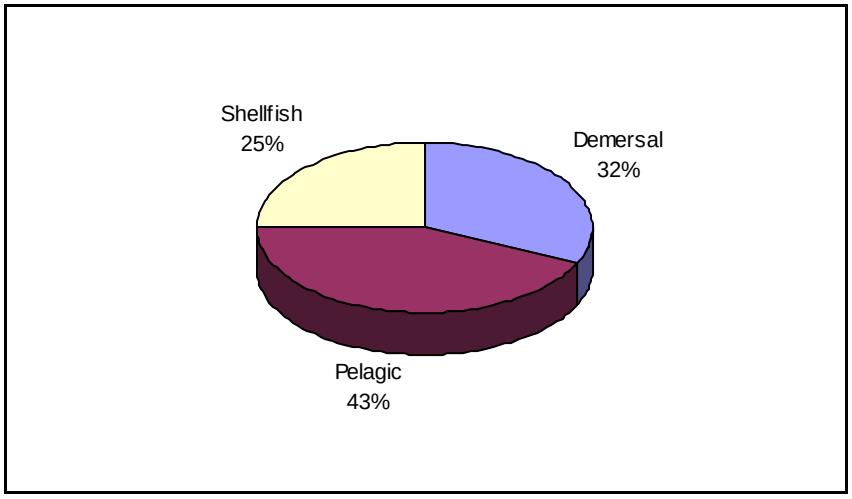


Figure 19. 2005 Landings by Fish Type (United Kingdom Sea Fisheries Statistics, 2005).

Due to the distribution of some of the main fishing grounds in the northern North Sea, there is a disproportionate amount of landings for Scottish ports which are closer to these areas. For example, in 2005, 25 percent of all U.K. landings (by the U.K. fleet) were landed in Peterhead (NE Scotland) and a further 19 percent landed in Lerwick (Shetland).

In terms of numbers, there were 6,341 U.K. registered fishing vessels in the U.K. commercial fishing fleet (excluding the Channel Islands), in 2005. Of these, 4,833 were under 10 meters (33 feet) in length[1] (Figure 20).

[1] A distinction is made between >10m and <10m vessels because under U.K. and European fisheries legislation, only vessels of >10m length have to provide details on landings.

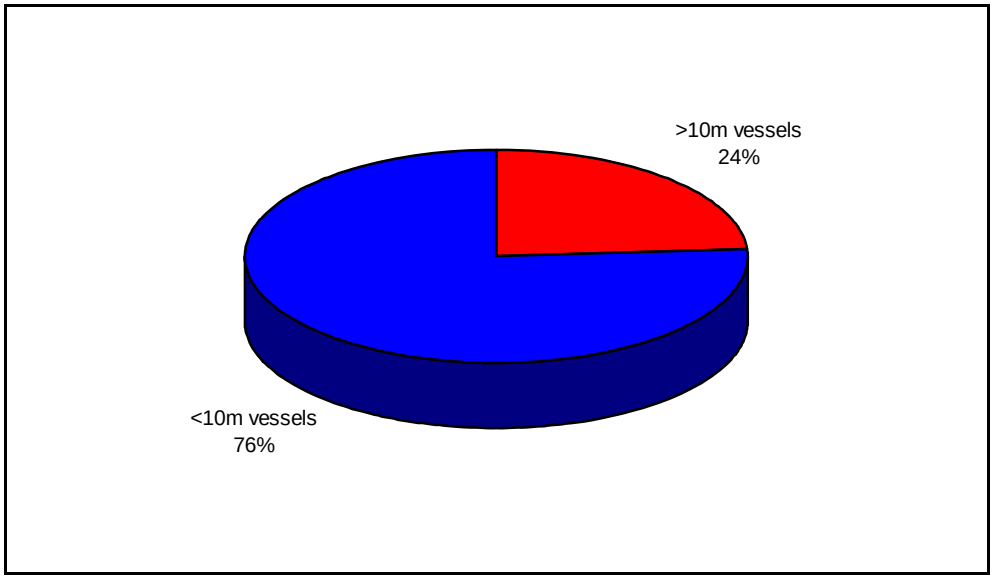


Figure 20. Proportion of >10 meters and <10 meters registered U.K. fishing vessels in 2005 (United Kingdom Sea Fisheries Statistics, 2005).

The numbers of fishing vessels and full-time fishermen have declined steadily since 1995 (see Figures 21 and 22). These quite drastic reductions in fleet size and numbers of fishermen have been caused, in large part, to an on-going decommissioning scheme undertaken by the Multi-Annual Guidance Programs (MAGP) of the Common Fisheries Policy (CFP). This program provides a framework for bringing fleet capacity across the EU in line with the available fishing opportunities. The fourth such program covering the years 1997-2001 was agreed to in 1997, and extended to run until the end of 2002.

The U.K.'s position at the end of MAGP IV at the end of 2002 was that the overall fleet capacity objectives were complied with as well as the majority of the objectives for individual segments.

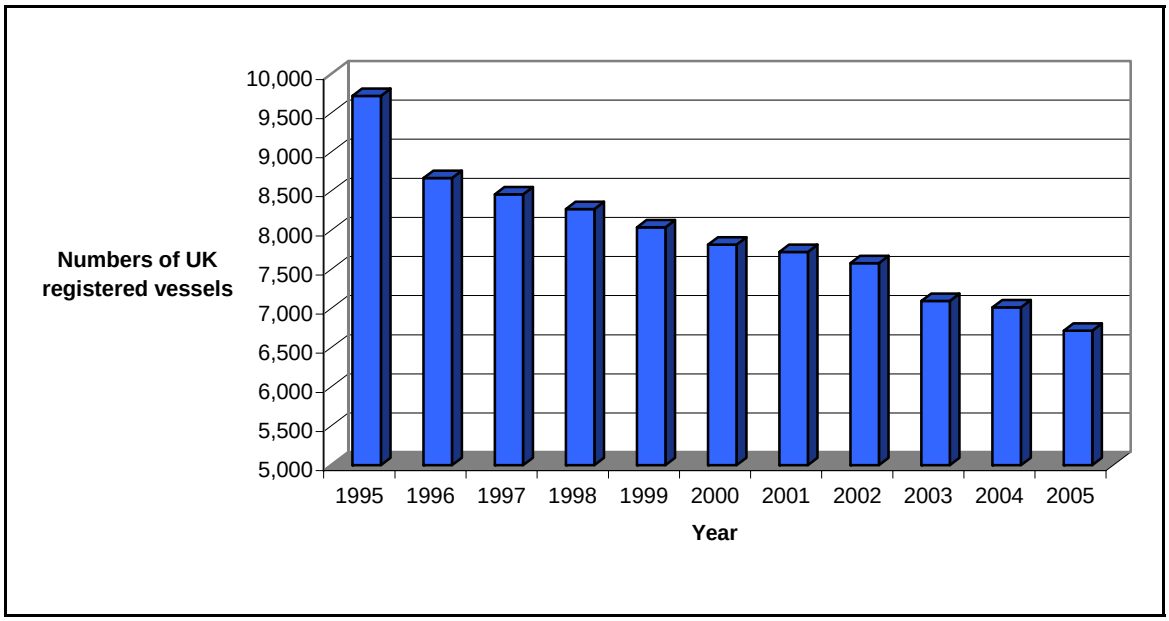


Figure 21. Numbers of U.K. registered fishing vessels, 1995-2005 (United Kingdom Sea Fisheries Statistics, 2005).

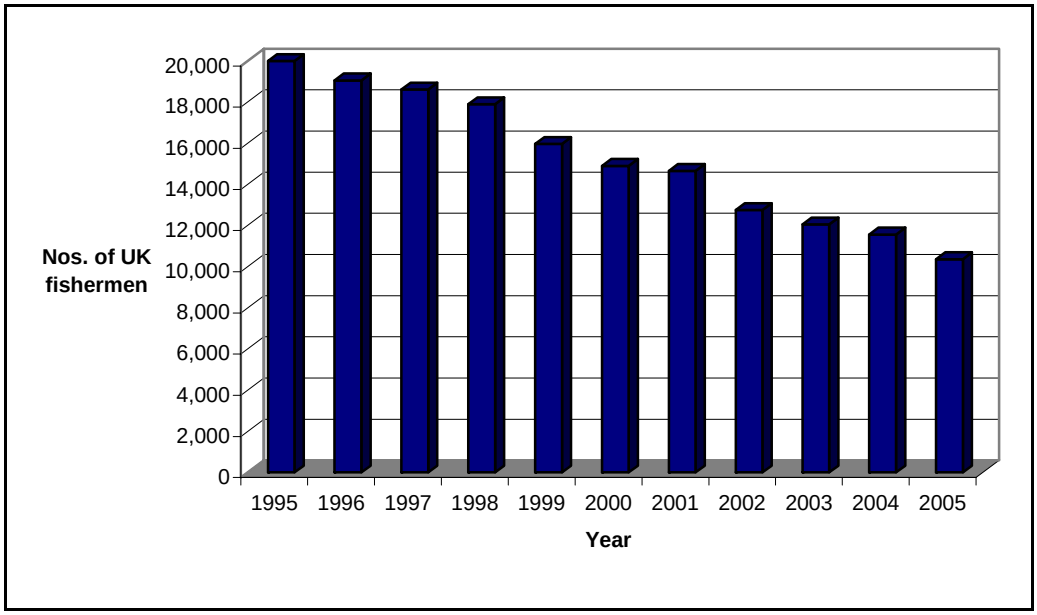


Figure 22. Numbers of U.K. fishermen, 1995-2005 (United Kingdom Sea Fisheries Statistics, 2005).

3.3.2 U.K. Recreational Fishing Industry

There is less formal data and information on the U.K. recreational fishing industry in comparison to the commercial sector. However, in the last five years, the focus on the recreational fishing industry of the U.K. has increased dramatically (Table 35). This shift is largely due to the efforts of bodies such as the National Federation of Sea Anglers (NFSA) who have raised the awareness of this sector in order to provide input into recent U.K. marine policy and strategy developments, i.e., the forthcoming U.K. Marine Bill and Marine Spatial Planning.

Table 35

U.K Recreational Fishing Industry – Key Facts

- Recreational sea angling is a major industry in the U.K.
- A recent research report estimated that 1.1 million households contain at least one member who had been sea angling in the past year.
- Participation is greatest in the northeast of England, south of England, and Wales.
- 54 percent of sea anglers fish mainly from the shore, 23 percent from private boats and 22 percent from charter boats.
- The economic value of recreational sea angling was estimated at £538 million ($1 billion) per year.
- Boat anglers made over 50 percent of all expenditures, with 37 percent contributed by shore anglers.

Source: Drew Associates, 2004.

In particular, much work has been done in recent years to try and quantify the economic contribution of recreational sea angling, in comparison to that of commercial (inshore) fishing. A research report, funded by DEFRA, which discusses the economic contribution of sea angling to the U.K. provides much of the recent information about the impact of recreational sea angling (Drew Associates, 2004).

For example, this report identified the important local centers for sea angling, its economic contribution both nationally and regionally, and the value of the experience to anglers. The study found that residents engage in recreational sea angling all along the coast of England and Wales, with its rivers, estuaries and sheltered ports providing a huge and diverse range of options for sea anglers.

The report also indicated that 1.1 million households contain at least one member who had been sea angling in the past year. Participation is greatest in the northeast of England, south of England, and Wales. Shore angling is the most popular method of fishing, with 54 percent of sea anglers fishing mainly from the shore, 23 percent from private boats and 22 percent from charter boats.

In terms of the economic contribution[2] of recreational sea angling in England and Wales, the total expenditure by anglers resident in England and Wales was estimated as £538 million ($1 billion) per year from 12.7 million angler days of activity. Around half of the expenditure (52%) was by boat anglers and reflects the importance of capital expenditures on boats and equipment. Shore anglers were the next most important group (37% of the total expenditure). In terms of first round impacts on the spending translates into 18,889 jobs and £71 million ($140 million) in suppliers' income. Multiplier effects were not measured.

3.3.3 Comparison between the Industries

The aim of this section of the report is to provide a comparison between marine aggregate extraction and commercial and recreational fisheries in the U.K (see Table 36). The objective of this comparison is to provide a degree of context as to the relative scale, magnitude, level of employment, and turnover in the two industries. By doing this it will be easier to critically assess the potential conflicts between the two industries in later sections.

Table 36

Comparison between Industries

<table>
<tr><th rowspan="3">Measure</th><th colspan="3">SECTOR</th></tr>
<tr><th rowspan="2">Marine Aggregate Extraction</th><th colspan="2">Fishing</th></tr>
<tr><th>Commercial Fishing</th><th>Recreational Fishing</th></tr>
<tr><td rowspan="2">Number of Employees</td><td rowspan="2">2,500 direct jobs</td><td>Approximately 11,000 full time fishermen</td><td rowspan="2">NA
(although over 1 million persons are estimated to regularly go sea fishing)</td></tr>
<tr><td>>18,000 persons employed in fish processing industry</td></tr>
<tr><td>Direct Turnover</td><td>Gross output in 2003 = £132 million ($261 million)</td><td>Value of landings into U.K. ports = £513 million ($1,015 million)</td><td rowspan="2">Overall economic value estimated at £538 million ($1 billion)</td></tr>
<tr><td>Added Value</td><td>£68.6 million ($136 million)</td><td>U.K. fishing industry exported goods to the value of £881 million ($1.7 billion) in 2004</td></tr>
</table>

Sources: United Kingdom Sea Fisheries Statistics, 2005; British Marine Aggregate Producers Association, *Pers. Comm.*, 2006.

An important point to note when viewing this comparison is that due to the spatial distribution of marine aggregate activity and commercial and recreational fishing activity, in certain areas, one industry may be significantly more important, in terms of employees and turnover, than another. Further details on the spatial distribution of marine aggregate extraction and commercial and recreational fishing activity are provided in the following sections.

[2] Any conclusions on the contribution of sea angling to the national economy have to be made with care. Cessation of the activity would not result in the loss of 18,890 jobs. Expenditure would be displaced into other directions with corresponding benefits to employment and income. Similarly any comparison of the economic characteristics of sea angling with those of commercial fishing is potentially open to misinterpretation. They represent quite different types of economic activity (a consumer activity by sea anglers, and a natural resource harvesting activity combined with processing, by commercial fishing).

3.3.4 Spatial Distribution of Marine Aggregate Extraction in U.K. Waters

There are currently 71 production licenses in existence around the shores of the U.K. Predominantly and historically, the main areas of extraction activity have been off the eastern and southern coasts of England, but licenses also exist in the Bristol Channel and Liverpool Bay. There are also two licenses in Scotland, one in the tidal section of the River Tay and one in the Firth of Forth (Figure 23). The East Coast region (those licenses from Winterton to Southwold off East Anglia) has provided a large proportion (approximately 47%) of the marine won aggregate in the past decade.

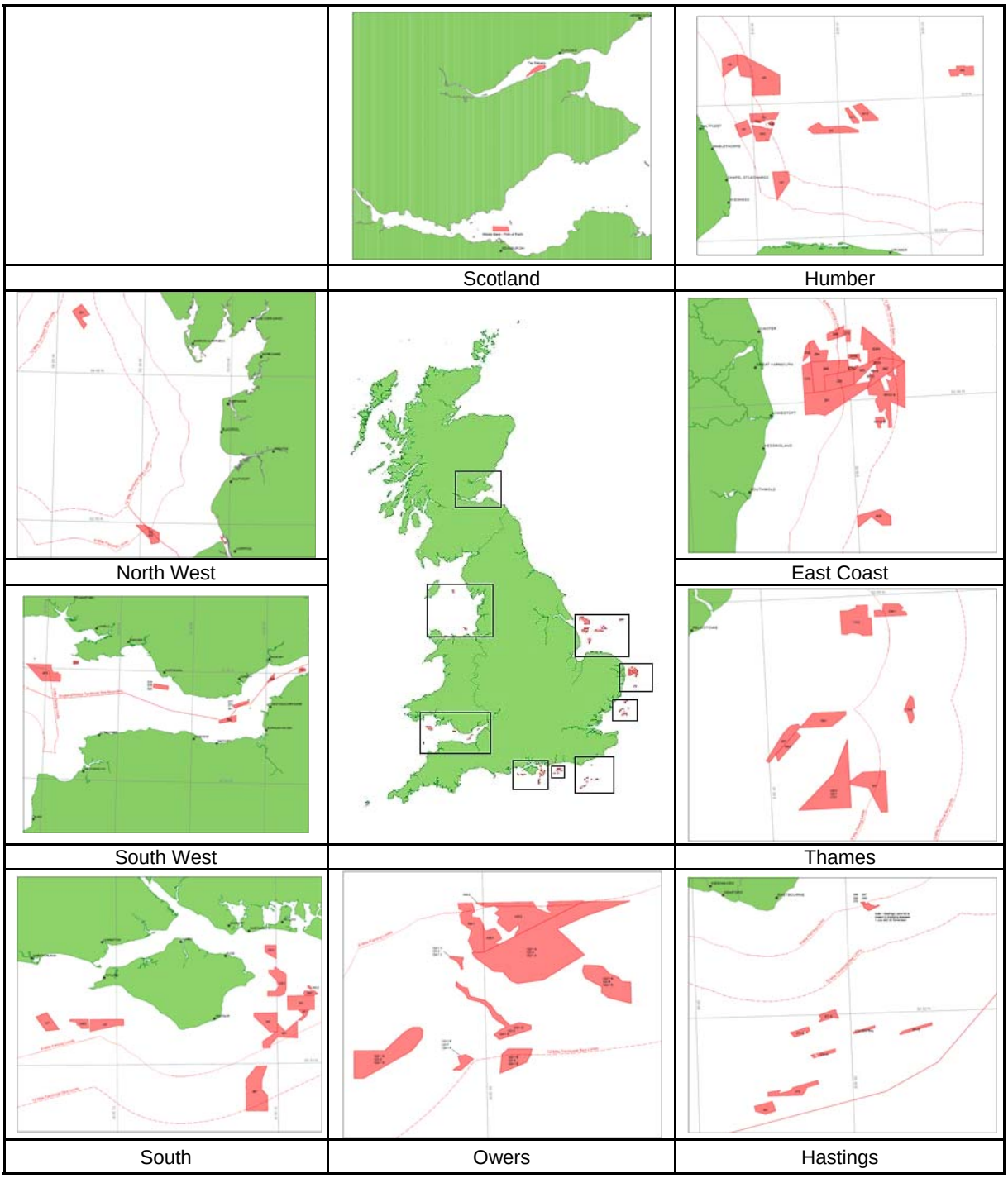


Figure 23. U.K. Licensed Dredging Areas (Crown Estate, 2007).

The second most important marine aggregate producing region is the South Coast, or that area between Bournemouth and Littlehampton (and including the HSB case study site). Figure 23 (above) indicates the location of existing licensed extraction areas within English and Welsh waters.

In terms of the actual area of seabed involved, summary statistics from 2005 (published by BMAPA and the Crown Estate) are shown below (Table 37).

Table 37

Marine Aggregate Extraction Key Facts

- A total of 21 million tons of sand and gravel were dredged from Crown Estate licenses in England and Wales during 2005;
- The total area of seabed licensed in 2004 decreased to 1,179 km^2 (1,257 km^2 in 2004);
- Dredging took place within 137.6 km^2, 11.7 percent of the licensed area, compared to 134.5 km^2 (10.7%) in 2004;
- 90 percent of dredging from Crown Estate licenses took place from an area of 45.42 km^2 (42.67 km^2 in 2004);
- The area dredged for > 1 hr 15 minutes per year (high intensity dredging) decreased slightly to 9.5km^2 (from 10.18km^2 in 2004).

Source: BMAPA, 2005.

In addition to existing licenses, there is an on-going program of new license applications around the U.K. Many of these are applications to renew existing licenses. However, there is one major area of new applications in the Eastern English Channel (EEC). The positions of these license application areas are shown in Figure 24.

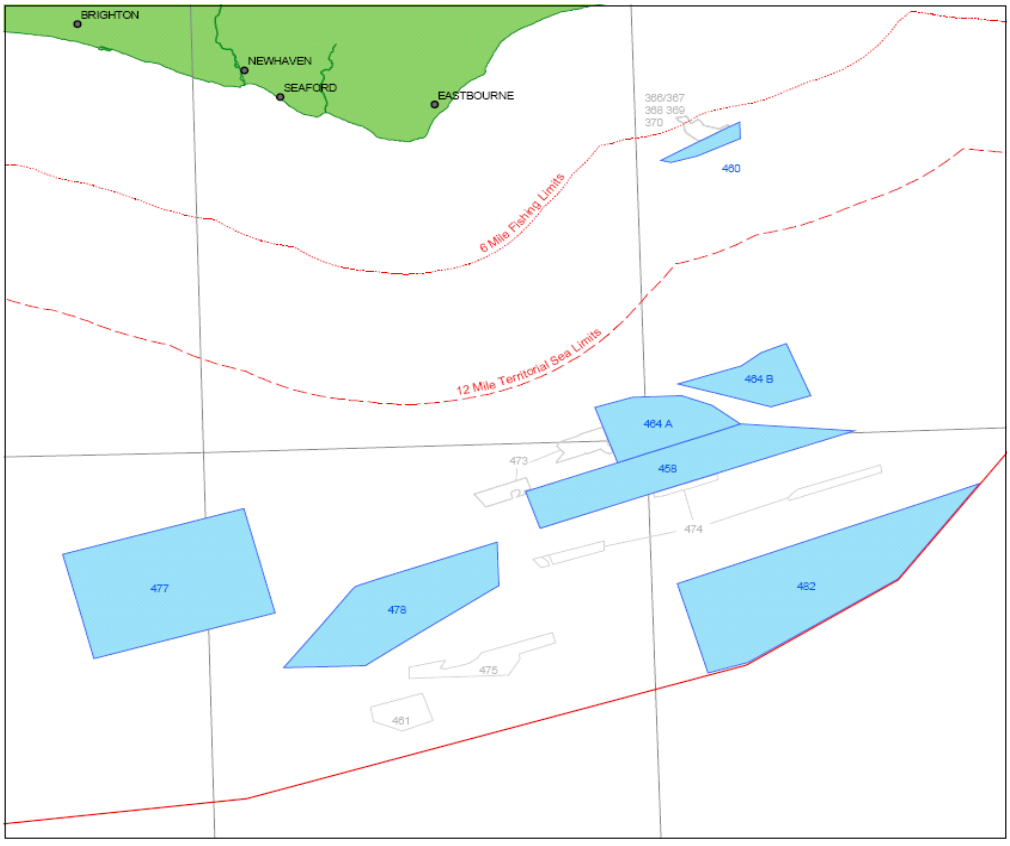


Figure 24. Position of New Aggregate Licenses in the Eastern English Channel (Crown Estate, 2006).

3.3.5 Spatial Distribution of Commercial and Recreational Fishing Activities in U.K. Waters

Whereas marine aggregate extraction is currently limited to a series of well-defined license areas in certain parts of the U.K. continental shelf, commercial fishing activity is much more widespread and takes place in the vast majority of U.K. waters. In fact, there are very few places that a licensed fishing vessel cannot operate in U.K. waters, with only one formal No-Take Zone for commercial fishing activity currently in existence (part of the Lundy Island Marine Nature Reserve). Local by-laws exist in many places that prevent the use of certain gears in certain areas, e.g., no trawling is permitted within three nautical miles of the North Norfolk coast in order to avoid conflict with the static gear crab fishery that exists there, but generally, commercial fishing activity is widespread with limited spatial restrictions.

The wide scale distribution of commercial fishing activity is also a product of the nomadic nature of many types of fishing, with fishermen needing to move around in order to target mobile stocks. Therefore, compared to the well-defined areas in which marine aggregate extraction occurs on the U.K. continental shelf, the spatial distribution of commercial fishing activity is much greater.

The main constraint on the spatial distribution of commercial fishing activity is the vessel size itself, with smaller vessels (less than ten meters or 33 feet) tending to fish close to their home ports. Larger vessels can fish in wider areas, but as we can note from Figure 23 (above), 76 percent of the U.K. fishing fleet is less than ten meters and will, therefore, be restricted to where they can fish by their size. What this means is that the vast majority of commercial fishermen never have any conflict with marine aggregate extraction due to the simple fact that they fish in areas where marine extraction does not take place.

However, in areas where marine aggregate extraction does occur there is the potential for conflicts to arise with commercial fishing activity. For the purpose of this study, a brief description is provided of the main commercial fisheries in the main aggregate license areas around the U.K. Much of these data have been obtained from license-specific Environmental Impact Statements (Table 38).

Table 38

Overview of Commercial Fisheries in the U.K. Marine Dredging Regions

Dredging Region	Overview of Main Commercial Fisheries
Humber	Commercial fishing activity in the Humber Region is undertaken by a range of vessels from a variety of ports along the Holderness coast and the Humber Estuary including Hull, Bridlington, Hornsea, Tunstall, Withernsea, Kilnsea, Spurn Head and Grimsby. Fishing in this area is dominated by potting activity with only some occasional, seasonal netting activity. Key species for the potting fishery include brown crab, lobster, velvet crab and whelk. The potting industry in this area is flourishing, with large number of new vessels being built.
East Coast	The fishery in this area is characterized by a large number of relatively small boats (mostly less than 33 feet), each using a variety of fishing methods according to season and abundance of target species. The fleet that fishes off the East Anglian coast can be described as comprising three sectors: • Inshore sector, comprising vessels of less than eight meters or 26 feet in length working up to around 8 km offshore; • Middle ground sector. This comprises boats of between approximately 26 and 49 feet in length working mostly between 8 and 50 km offshore; and • Offshore sector, consisting of vessels of more than 15 meters or 49 feet and capable of working across wide parts of the southern North Sea. This sector comprises mostly stern trawlers, beam trawlers, gill and wreck netters and larger longline vessels.
Thames	The commercial fishery of the Greater Thames Region includes a well-established cockle fishery in the outer Thames Estuary plus a diverse fleet made up of vessels from ports in Essex and Kent. Based on a study undertaken in 2001 by the Essex Estuaries Initiative (2001), almost 60 percent of vessels in this region are less than 10 meters and use a variety of gears throughout the year. Important fishing grounds exist in close proximity to existing aggregate license areas.
South Coast	The South Coast supports a diverse commercial fishery, although potting for crab and lobster is of particular importance. Trawling also takes place, where permitted for a wide range of species. Another key fishery in this area is netting, with drift netting occurring through the summer months, principally targeting bass. Recreational fishing aboard charter vessels is of particular importance in the South Coast region, mainly due to the large number of harbor facilities and good angling grounds (rocky reef areas and large sandbank features for bass etc.)
South West (Bristol Channel)	Commercial fishing in the Outer and Mid-Bristol Channel is extensive with vessels from a variety of ports along the North Devon and Cornish coasts, together with vessels from South Wales, taking a variety of species throughout the year. Extensive potting, trawling and netting fisheries exist in the Bristol Channel. In the inner Bristol Channel, commercial fisheries activity is at a much lower level. This comparative lack of commercial fisheries activity is principally attributed to the large tidal range (making the use of nets and trawls more difficult), together with a relatively low density of fish of Minimum Landing Size (MLS), with the majority of fish found within the Estuary being juveniles. The greatest effort within the Inner Bristol Channel and Lower Severn Estuary is generally directed to leisure or recreational angling both from the shore and by boat. This includes private vessels or those of angling clubs, together with commercial charter angling vessels operating from a number of ports.

Source: Emu Ltd, 1999; Emu Ltd, 2005a; Emu Ltd, 2005b; Emu Ltd, 2006; Thames Estuary Partnership, no date; Emu Ltd, unpublished.

3.4 The U.K. Regulatory Environment for Marine Aggregate Extraction

Policy Framework. Proposed new government policy on aggregate extraction is currently set out in the draft Minerals Policy Statement (MPS) 1 Planning and Minerals and its associated Good Practice Guidance (GPG). MPS1 will set out the Government's key policies and principles for minerals planning in England. When in force, MPS1 will replace the statements of common minerals policy in MPG1, MPG6 and some other MPGs (previously, MPG6, which was published in 1994, set out principles for identifying areas where aggregate extraction might be appropriate, and criteria for assessing the suitability of policies as well as site specific proposals. The use of marine aggregate was advocated in this guidance and it was a key influence in the growth of the industry).

Marine Minerals Guidance Note 1 (MMG1). Specific policy guidance with respect to marine aggregate extraction is set out in Marine Minerals Guidance Note 1 (MMG1): Guidance on the Extraction by Dredging of Sand, Gravel and other Minerals from the English Seabed (ODPM, 2002).

MMG1 gives more detailed advice than in the past on the environmental standards that must be met and criteria against which applications will be considered and determined. Annex A of MMG1 also gives guidance on the scope and content for Environmental Impact Assessments (EIA). MMG1 also sets out the Government's policy objectives for marine mineral extraction, under a number of headings, all under the umbrella of sustainable development. These policy objectives include:

- Minimizing the area authorized for dredging at any one time;
- Ensuring that current resources are used to their maximum potential;
- Identifying new areas for dredging; and
- Safeguarding resources for specific uses.

Some attention is paid to the possibility of cumulative and in-combination effects of a number of extraction areas, when these are up and running or the subject of current applications. It is suggested that the Government will seek to "zone" some areas, through co-operation with the Crown Estate and the industry to limit the extent of groups of workings, and at the same time minimize the impact of concentrations of dredging where necessary. In terms of safeguarding resources for specific issues, it is necessary when dealing with applications to consider the need for beach nourishment material. However, the additional guidance is still rather general, and does not set out a framework to:

- Indicate preferred areas of search in terms of future potential aggregate extraction areas based on existing constraints; and
- Indicate in terms of "lines on maps" whether a particular area is more likely to be acceptable than another.

Consequently, applications for licenses will continue to be dealt with on a case-by-case basis.

Administrative Bodies. The current procedure for the consent of marine aggregate extraction is administered by the DCLG for applications within English waters. The Department for Environment, Food and Rural Affairs (DEFRA) has a particular responsibility for overseeing and monitoring the effects of dredging. The Crown Estate acts solely as landowner but monitors tonnage removal and compliance with license conditions.

Government control of marine aggregate dredging is currently exercised through the non-statutory Interim Government View Procedure (IGVP) administered by the Minerals and Land Reclamation Division of the DCLG. However, since 1997, the U.K. government has been working on a new statutory system to replace the Interim GV Procedure.

The existing process is broadly split by two main licenses, as follows:

(1). Prospecting licenses:

- Awarded through tender process by the Crown Estate.
- Successful tenderer has limited time to survey for suitable deposits using a variety of techniques including side scan sonar, seismic profiler, bathymetric survey, grab sampling, vibracore sampling, or bulk sampling using a dredger.
- After the location of a viable deposit, an application is made to the Crown Estate for a production license; hereby the Interim Government View Procedure (IGVP) begins.

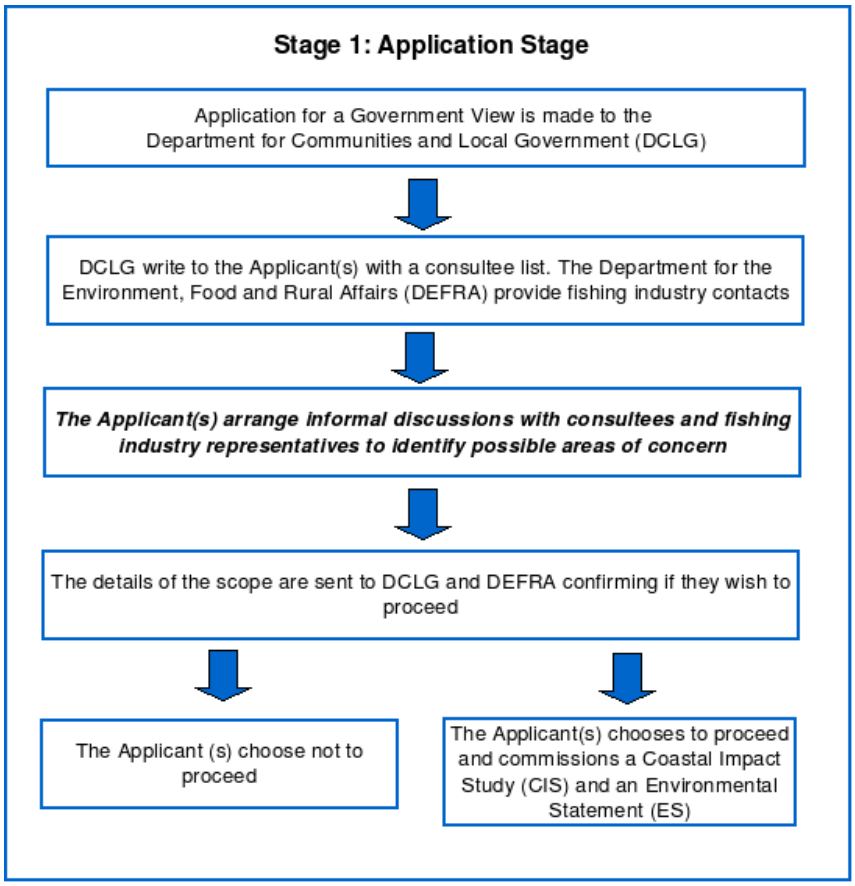
(2). Production licenses:

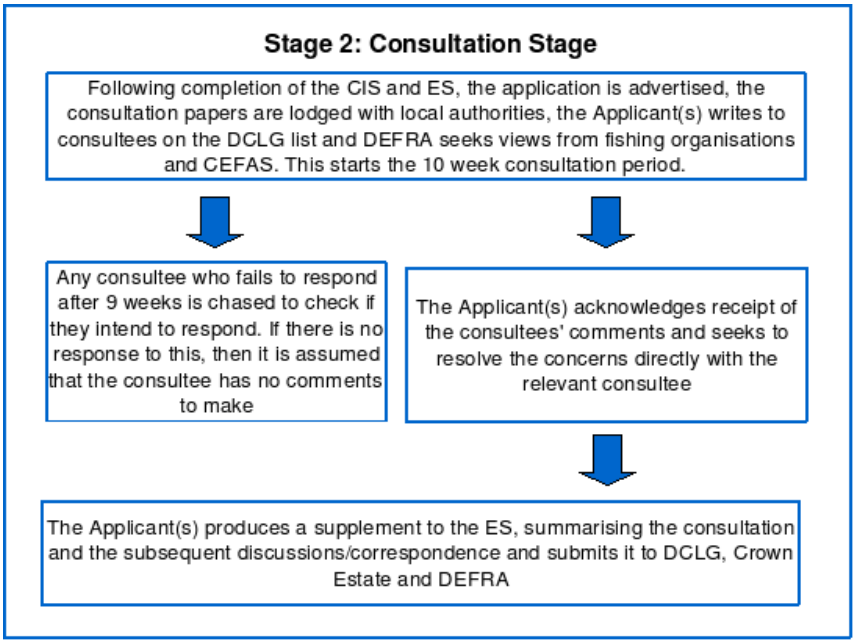
- Awarded according to the IGVP published by Planning DCLG.

The Interim Government View Procedure (IGVP). The Interim Government View Procedure was introduced in 1968. Under this non-statutory system, the Crown Estate undertook only to issue dredging licenses if the Government indicated they were content that the impacts on the environment were acceptable. The level of information required to assess these impacts has progressively increased as more has become known about the marine environment. Since 1989 it has been necessary for the dredging applicant to undertake an EIA as part of the IGV procedure.

In 1998, the Department of Environment, Transport, and the Regions (DETR) introduced new 'Interim Procedures,' under which all current applications progress. These are still non-statutory but more stringent than their predecessors, and are also intended to make the application and determination process faster and more transparent. Guidance on the Interim Procedures was published in May 1998 (DETR, 1998).

These procedures comprise five stages, which are summarized below in Figure 25.


Stage 1: Application Stage
Application for a Government View is made to the Department for Communities and Local Government (DCLG)
DCLG write to the Applicant(s) with a consultee list. The Department for the Environment, Food and Rural Affairs (DEFRA) provide fishing industry contacts
The Applicant(s) arrange informal discussions with consultees and fishing industry representatives to identify possible areas of concern
The details of the scope are sent to DCLG and DEFRA confirming if they wish to proceed
The Applicant (s) choose not to proceed
The Applicant(s) chooses to proceed and commissions a Coastal Impact Study (CIS) and an Environmental Statement (ES)


Stage 2: Consultation Stage
Following completion of the CIS and ES, the application is advertised, the consultation papers are lodged with local authorities, the Applicant(s) writes to consultees on the DCLG list and DEFRA seeks views from fishing organisations and CEFAS. This starts the 10 week consultation period.
Any consultee who fails to respond after 9 weeks is chased to check if they intend to respond. If there is no response to this, then it is assumed that the consultee has no comments to make
The Applicant(s) acknowledges receipt of the consultees' comments and seeks to resolve the concerns directly with the relevant consultee
The Applicant(s) produces a supplement to the ES, summarising the consultation and the subsequent discussions/correspondence and submits it to DCLG, Crown Estate and DEFRA

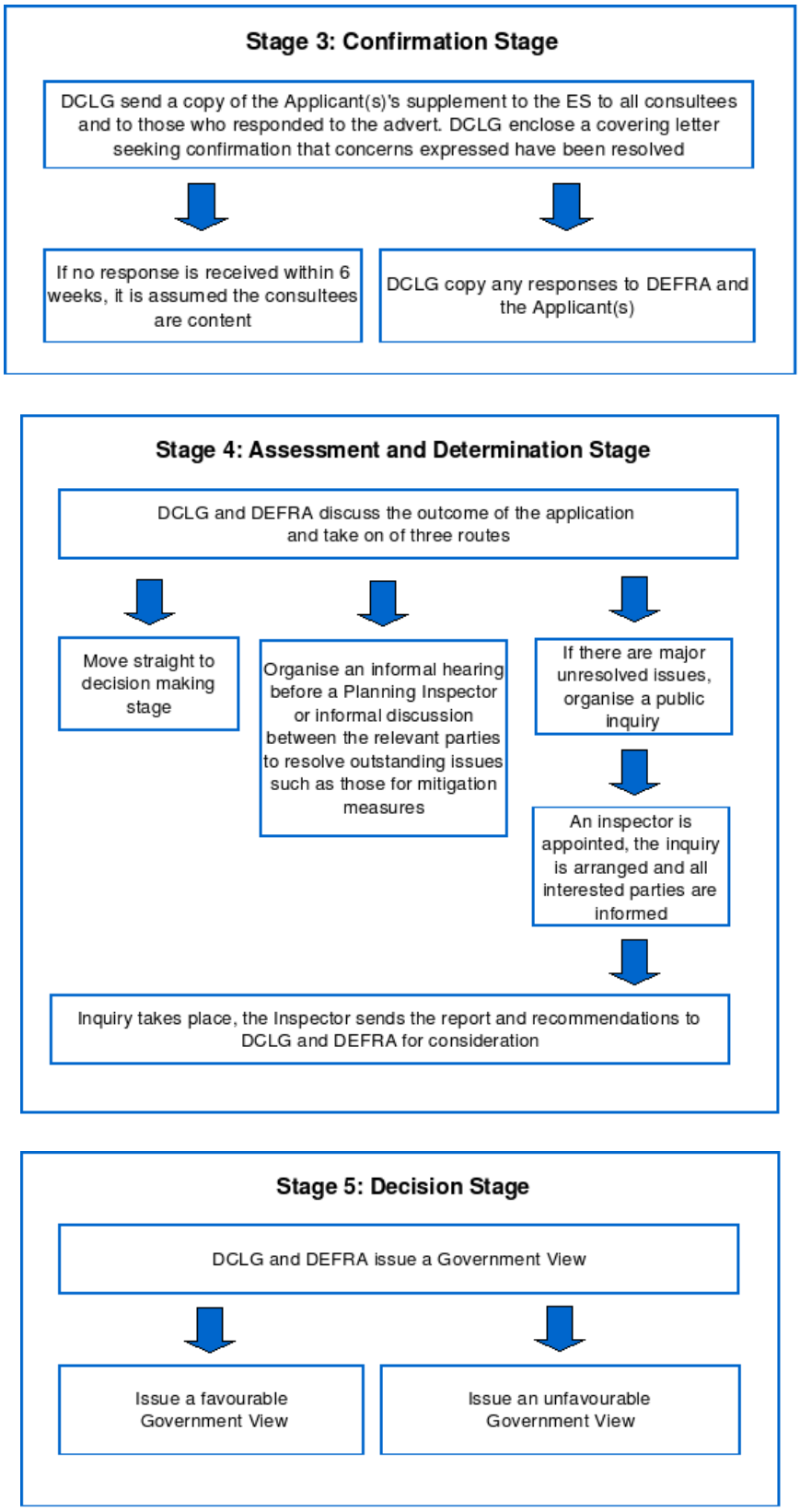


Figure 25. The U.K. Interim Government View Procedure (DETR, 1998).

Pending New Statutory Approach to the Regulation of Marine Aggregate Extraction. As outlined earlier, the current system, described above, is in the process of transition from a non-statutory regime to statutory regulation. The U.K. Government has been working on the production of a statutory control for marine aggregate extraction since 1997, but no regulations have been made as yet. The consultation paper on the draft regulations was issued in June 2006.

These new regulations[3] will replace the IGVP when they come into force (Vivian, 2003) and will transpose into U.K. legislation, in so far as marine dredging is concerned, the provisions of EC Directive 85/337/EEC, as amended by EC Directive 97/11/EC, on the assessment of the effects of certain public and private projects on the environment.

The new regulations will separate the Crown Estate from the environmental consideration of dredging proposals; in England, the Crown Estate will still issue commercial licenses but these will become distinct from the dredging permission issued by the DCLG (Marker, 2003).

EC Directive 85/337 on the Assessment of the Effects of Certain Private and Public Projects on the Environment (as amended by EC Directive 97/11, and Regulated according to Statutory Instruments 1999, No. 293). This Directive was implemented in the U.K. through the Town and Country Planning Regulations 1998 (SI 1998 No. 1199) with subsequent amendments. Projects have been grouped into two main categories, which are listed as Annexes depending on their likely impact on the environment. Projects that fall into Annex I are those which are predicted to have a significant impact on the environment. It is obligatory for an Environmental Impact Assessment (EIA) to be undertaken for all these projects. All projects in Annex II are determined on a case by case basis depending on the scale, nature and location of the project. The extraction of minerals falls into Annex II-c. However, under the conditions laid out in the Government View Interim Procedures and the nature and scale of this dredging application, a full EIA is always required. In addition to a full EIA, it is also a requirement in U.K. waters that a Coastal Impact Study (CIS) is undertaken. Further details on EIA and CIS are provided below.

The 97/11 EC amendment implemented new requirements on Trans-boundary Consultation (implemented in the U.K. in March 1999 as Statutory Instrument 193). However, as Area 401/2 is not in close proximity to the territorial waters of a member state, the trans-boundary issues outlined in the 97/11 EC Directive do not need to be addressed.

3.5 The Hastings Shingle Bank

3.5.1 Overview

The Hastings Shingle Bank (HSB) is a large shingle bank feature located approximately 13 kilometers south of Hastings on the south east English coast. Based on geological interpretation, it appears that HSB is part of a series of submerged beaches, which run parallel to the English coast and converge towards the Straits of Dover.

The bank is located in approximate depths of between 15 and 23 meters below chart datum (CD). The location of the current HSB license area and the proposed South Hastings area (Area 460) is shown below (Figure 26).

[3] Environmental Impact Assessment and Habitats (Extraction of Minerals by Marine Dredging) Regulations 2007

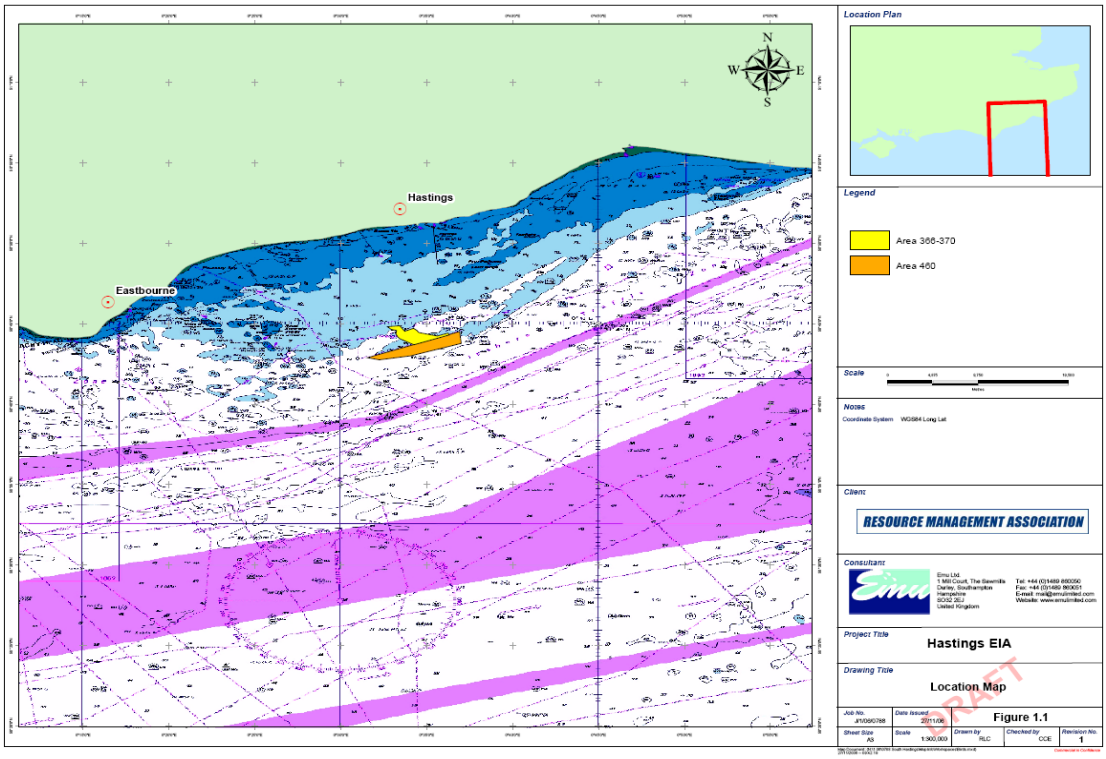


Figure 26. Position of Existing HSB License Areas (Areas 366-370) and Proposed South Hastings Application Area (Area 460) (Emu Ltd, unpublished).

3.5.2 History of Marine Aggregate Extraction on the HSB

An initial license to extract marine aggregates from the HSB was granted in 1989. Subsequent renewals to this license, in 1996 and 2001 have resulted in dredging continuing to the present day. Details of the licenses issued for dredging on HSB are summarized below in Table 39.

Table 39

Details of Dredging Activity on HSB since 1989

Details	License No. 1	License No. 2	License No. 3 (existing)
Granted	January 1, 1989	November 29, 1995	May 8, 2001
Term	Limited by tonnage	Five years	Ten years
Tonnage	7.5 million tons	15 million tons	Up to 30 million
Annual Limit	--	Max. of 5 million tons	Max. of 5 million tons

Source: Resource Management Association, *Pers. Comm.*, 2006

The actual amount extracted from this area since 1989 is shown below in Figure 27.

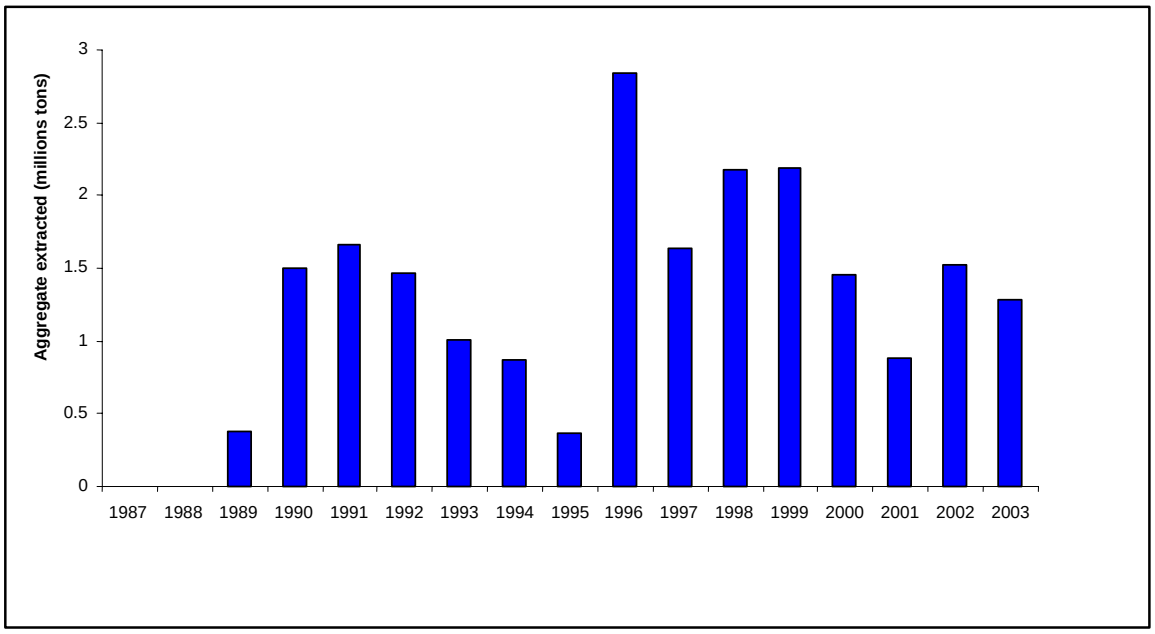


Figure 27. Amount of Aggregate (tons) Extracted from HSB between 1989 and 2003 (Resource Management Association, *Pers.Comm*., 2006).

With respect to the intensity and spatial distribution of extraction from within HSB, Figure 28 (below) presents the outputs of the electronic monitoring systems (EMS) used aboard dredgers working on the HSB since 1995. The differing colors shown correspond to differing intensities of dredging. These data can be used to (1) identify any "out of box" incidents, i.e., show where a dredger has extracted material outside the boundary of a licensed area, and (2) build up plots showing the intensity of dredging in a license area in any one year.

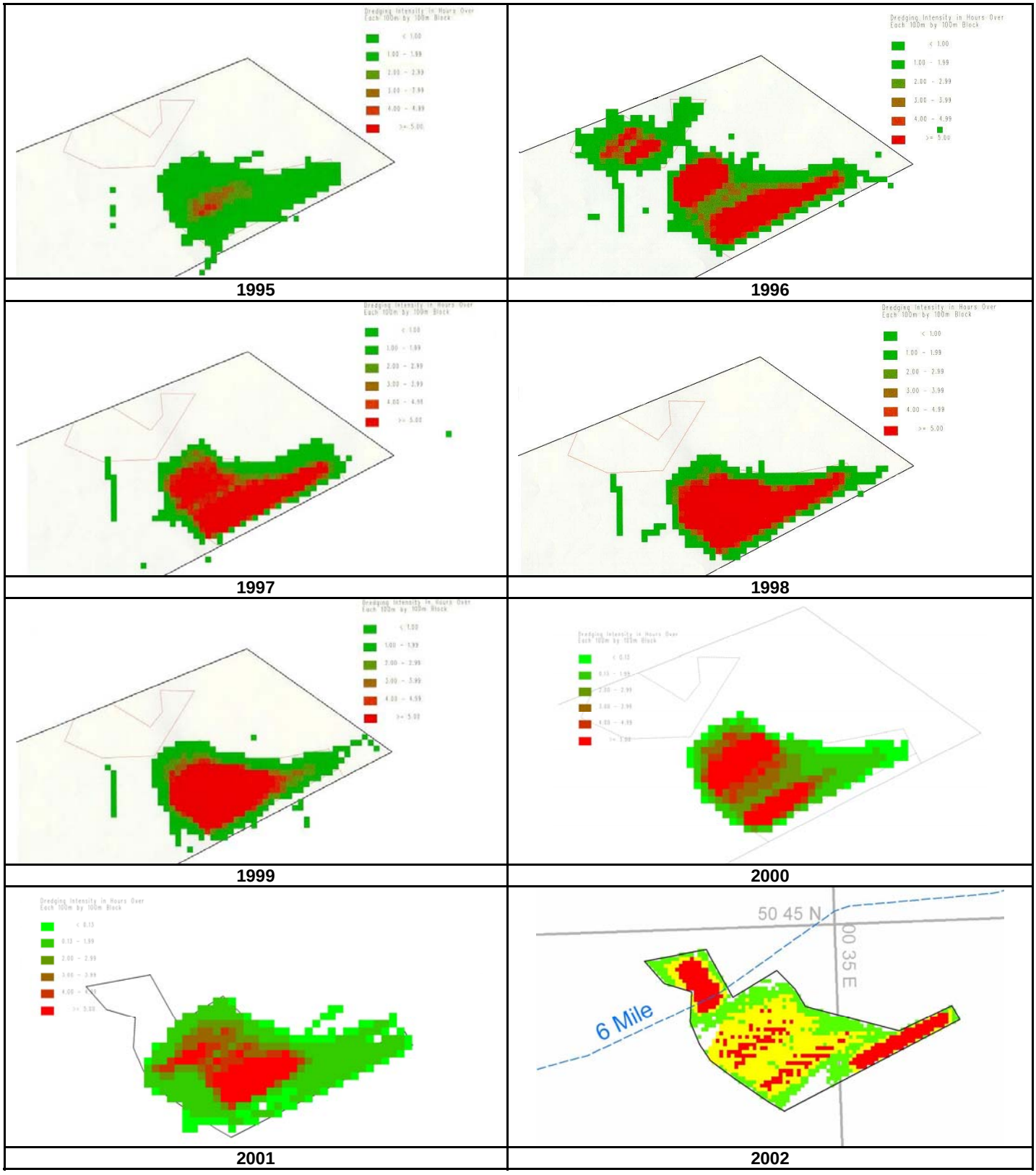


Figure 28. Dredging intensity at HSB, 1995-2003 (EMS data collected by the Crown Estate; Resource Management Association, *Pers.Comm.*, 2006).

3.5.3 History of Commercial Fishing Activity on the HSB

3.5.3.1 Introduction to Commercial Fisheries on the HSB

As is typical of most of the U.K. inshore waters, a well-established commercial fishery exists in the wider study area around the HSB. The main fisheries inshore of the HSB include potting for crab (*Cancer pagarus*), lobster (*Homarus gammarus*), and whelk (*Buccinum undatum*), netting for white fish such as bass (*Dicentrarchus labrax*) and sole (*Solea solea*), trawling for demersal species, scallop dredging and leisure angling. Of particular note in the inshore area is the Hastings sole fishery. This is a traditional fishery in the inshore area between Eastbourne and Rye which is prosecuted by beach launched boats from Hastings using set nets. Set nets are laid in the area to the north of the HSB from March, when migrating sole move inshore. In fact, this fishery has just been awarded the highly regarded Marine Stewardship Council (MSC) Standard. The MSC Standard is the only internationally recognized set of environmental principles for measuring fisheries to assess if they are well managed and sustainable.

Trawling and some potting, especially for whelks, takes place offshore of the HSB, although this is dominated by larger vessels, including some from other European countries (France and Belgium).

3.5.3.2 The Brown Crab Fishery

With respect to the HSB area itself, the brown crab fishery has dominated this area since the early 1980s. Mr. Peter Storey, currently skipper of the Royal Sovereign, established a successful brown crab (*Cancer pagarus*) fishery in the early 1970s after discovering a westerly movement of migrating crabs along the southern edge of the HSB between July and October. Since around 1982, Mr. Storey has set strings of baited crab pots along a north-south axis across these slopes, especially to the south and east of the gravel extraction area. Since 1982, this fishery, based around this single boat, has produced 50-100 tons of brown crab each year and has proved extremely important to Mr. Storey.

Landings of brown crab, expressed as Landings Per Unit Effort (LPUE) for the period 1985 to 2003 from this fishery are shown in Figure 28. The main fishing areas targeted by Mr. Storey are shown in Figure 30, along with the location of the existing HSB dredging area and the proposed Hastings South application (Area 460).

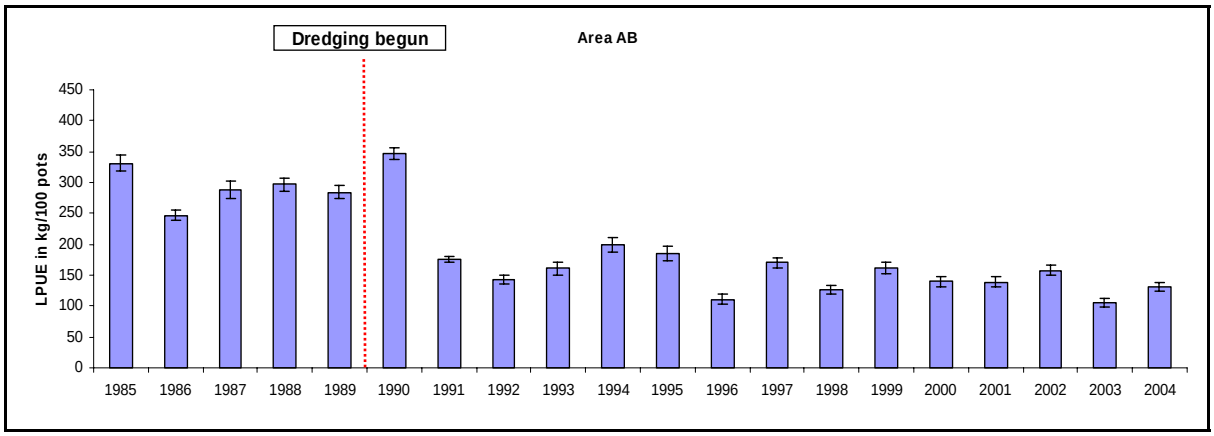


Figure 29. Mean autumn Landings per Unit Effort (LPUE) for Area AB (main fishing area), 1985-2003 (P. Storey, *Pers. Comm*., 2005).

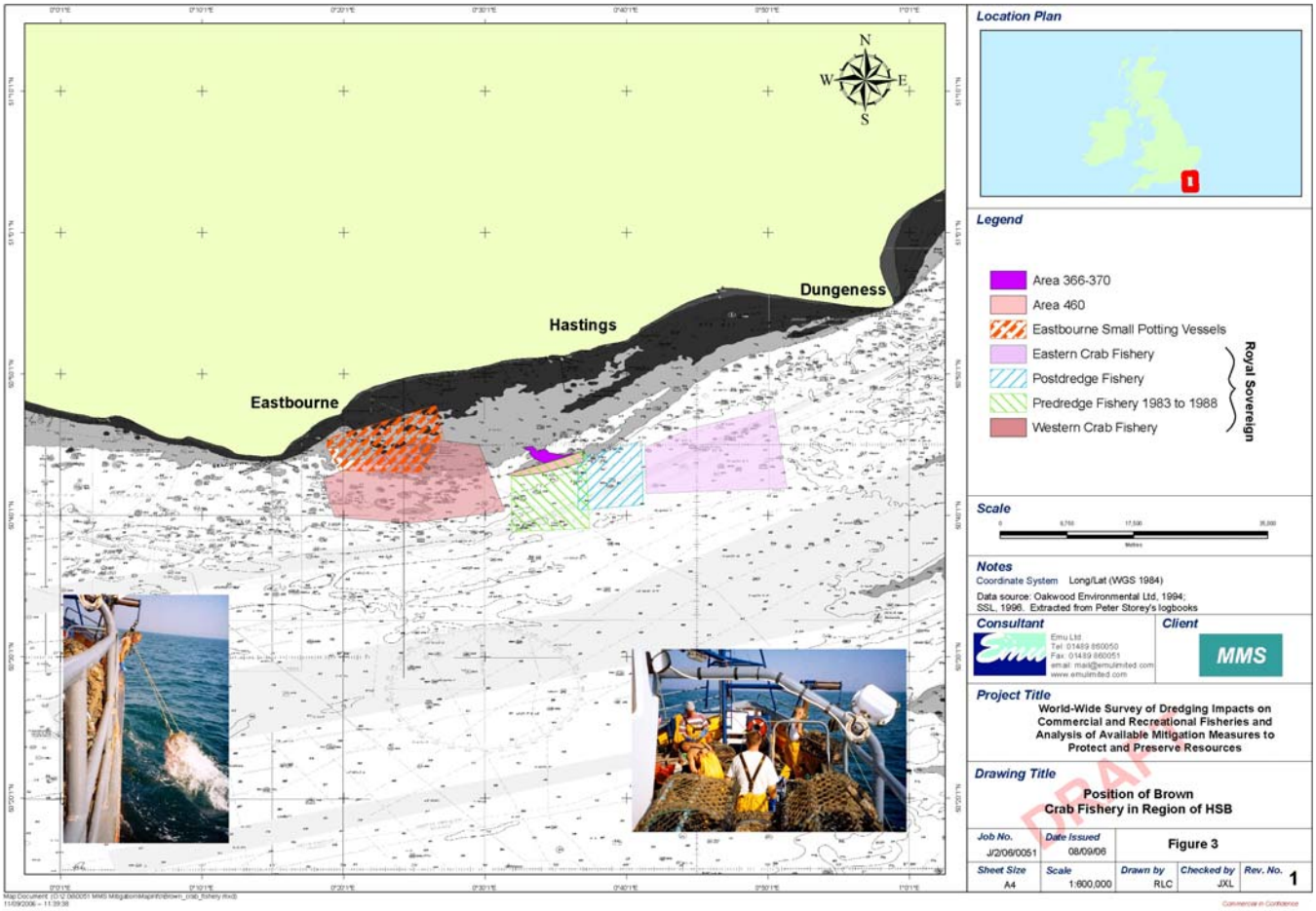


Figure 30. Fishing areas targeted by Mr Storey (P. Storey, *Pers. Comm*, 2005.)

3.5.3.3 The Sole Fishery

Traditionally, the fixed net fishery for sole off Hastings has been one of the more important U.K. fisheries in the eastern English Channel. The main area of the fishery is the inshore areas between Eastbourne and Rye off the Sussex coast, which has been exploited by the Hastings fishing fleet through the use of set nets. This fishery starts in the offshore area, its southern extent being the HSB license area. Set nets are laid here from March each year, when early migrating sole moving into the inshore waters are intercepted by the set net fishery. As this migration inshore continues, set nets are moved inshore and spread out over a larger area.

Normally, the Hastings fleet would attempt to lay all their nets in a very small area, possibly indicating a well-defined migratory pathway into the inshore areas. This area is approximately 5km offshore between Hastings and the HSB and is shown in Figure 31. It is postulated that sole moving across the HSB area are swimming in mid-water, since nets set further offshore in this vicinity fail to catch these migratory fish. As migration into the inshore area continues the fishery disperses, as the sole return to a demersal habitat and disperse to start spawning activity.

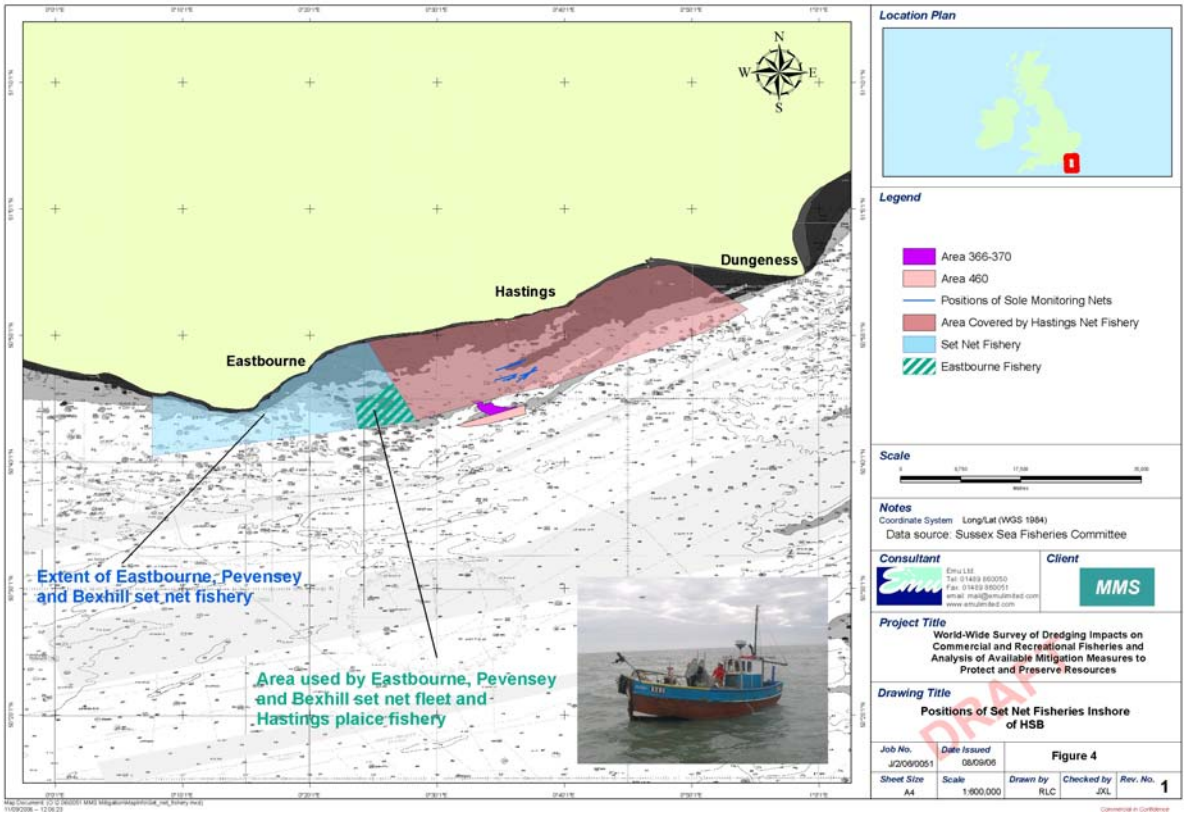


Figure 31. Fishing areas targeted by the Hastings Fleet (Sussex Sea Fisheries Committee, *Pers. Comm.*, 2006).

3.5.3.4 Hastings Fisheries Within Their Regional Context

The most recent landing statistics for Hastings (2003) show that the total fish landings were estimated at 1,883 tons with a value of £2.5 million ($4.8 million) (see Table 40). However, this data represents the data aggregated for Hastings, Eastbourne and Seaford, and therefore the total for Hastings is likely much lower (since it is just one of three ports).

The aggregated Hastings landings represents a small contribution to the total annual fish landings in both the English Channel (3%) and UK (<0.5%). However, the Hastings fisheries make a noticeable contribution to the local economy (IDDRA, 2007).

The composition of the Hastings fish landings is similar to the larger ports of Shoreham and Eastbourne, with six major species making up the bulk of the catch, i.e., bass, soles, plaice, scallops, crabs and whelks (IDDRA, 2007).

Looking at the regional level, i.e., Sussex, the two large ports of Shoreham and Eastbourne recorded total fish landings in 2005 of 3,200 tons, valued at £4.4 million ($8.6 million) (see Table 40). In terms of the English Channel fisheries as a whole, this represents 6 percent of the total landings and 7 percent of the total value, and undoubtedly makes a noticeable contribution to the local economy. However, compared to the total U.K. annual marine fisheries landings, Sussex landings made a relatively small contribution, equivalent to <1 percent both by weight and by value (IDDRA, 2007).

Table 40

Fish Landings in Three Sussex Ports – Eastbourne (2005), Shoreham (2005) and Hastings (2003)
(note: Hastings data also includes Eastbourne and Seaford)

	EASTBOURNE		SHOREHAM		HASTINGS	
	Quantity (tons)	Value (£/$)	Quantity (tons)	Value (£/$)	Quantity (tons)	Value (£/$)
Bass	21	144,000	42	220,000	27	173,000
Cod	26	41,000	27	43,000	60	88,000
Plaice	26	46,000	77	118,000	206	332,000
Sole	42	243,000	86	627,000	118	681,000
Other fish	55	65,000	346	470,000	165	195,000
Total fish	170	539,000	578	1,478,000	576	1,469,000
Crabs	175	188,000	3	2,000	175	178,000
Cuttlefish	75	53,000	138	110,000	0	0
Lobsters	15	160,000	1	10,000	16	154,000
Scallops	0	0	681	984,000	44	53,000
Whelks	1,170	710,000	183	98,000	938	473,000
Other shellfish	1	1,000	11	42,000	134	126,000
Total shellfish	1,436	1,112,000	1,017	1,246,000	1,307	984,000
TOTAL	1,605	1,651,000 $3,179,892	1,594	2,725,000 $5,248,459	1,883	2,453,000 $4,724,576

Source: MFA, 2003; MFA, 2005.

In the case of the wider regional context, i.e., the Eastern English Channel (ICES VII d), the available data shows some contrasting trends in landings over the past 20 years. Demersal landings have declined (by 40% for the main species) due to stricter regulations (see Figure 32). Shellfish (crab, lobster, scallop, squid) landings, by contrast, have increased over the same period, although it should be noted that for some species, such as crab, the overall trend has been highly variable and volatile from year to year (see Figure 33) (IDDRA, 2007).

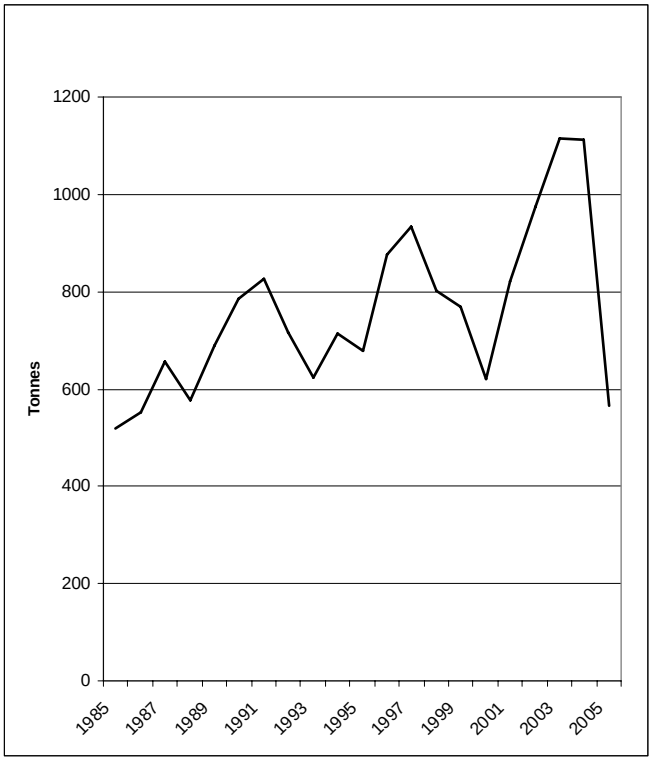


Figure 32. UK catches in the Eastern English Channel: Sole (EUROSTAT, 2007).

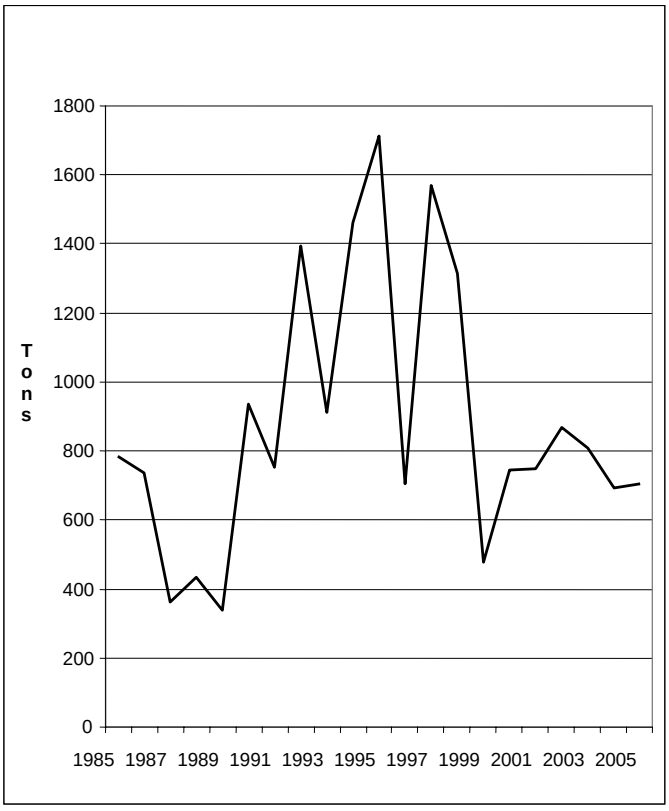


Figure 33. UK catches in the Eastern English Channel: Crab (EUROSTAT, 2007).

Finally, the English Channel contributed in 2005 nearly 8 percent (53,338 tons) of U.K. landings by weight, and 10 percent (£58 million/$112 million) by value. Of the total value in the English Channel landings, demersal species (soles, monks, bass etc.) generated £26 million/$50 million (first sale), shellfish (crabs, scallops) contributed £28 million/$54 million, and pelagic fish (mackerel, herring) contributed only £4 million/$8 million (IDDRA, 2007).

3.5.4 Main Conflicts between Aggregate Extraction and Commercial Fisheries in and around the HSB

The main areas of conflict between commercial fishing activity and marine aggregate extraction on the HSB can be divided into two discrete fisheries: (1) the brown crab fishery to the immediate south of the HSB; (2) and the net fishery for sole to the north of the HSB.

3.5.4.1 Conflicts Between the Brown Crab Fishery and Marine Aggregate Extraction

There is a well documented and historic record of conflict between aggregate extraction on the HSB and the brown crab fishery in this area. The main commercial fisherman in this area claims that aggregate extraction has caused a decline in his catches in pots located closest to the dredging area. It is claimed that this effect has been caused by the deposition of fine material from dredging activity within the HSB license area, resulting in a silting of his most northerly pots and an avoidance of these areas closest to the dredging by the westerly migrating crab.

Although it is claimed that dredging is the main source of these impacts, there is still continued debate between various organizations as to the exact physical pathway in which sediments from the dredging could end up in the dredging area, with the dredging companies stating that only small amounts of material will ever settle out in the crabbing area.

However, statistical monitoring of pots on a series of sentinel strings laid north-south do indicate a reduction in catches in those pots on the northern end of the string, i.e., closest to the dredging areas. Therefore, the Centre for Environment Fisheries and Aquaculture Science (CEFAS), the marine scientific advisers to the U.K. government have recently held a workshop that aimed to list and explore all potential mechanisms for the effect noted within this fishery. A summary of the potential sources of impact together with preliminary findings from this workshop are summarized below.

1. Seabed disturbance. Sidescan sonar imagery of the region in which HSB and the crab fishery are located shows widespread trawl marks on the sandy sea floor to the west and south of the main crab fishing area. Trawling activity may cause an increase in the release of fine sediments and organic material into the water column. Aggregate extraction will also release fine sediments into the water column. Preliminary analysis of sidescan and sediment data provided no evidence of accumulations of silts and clays in the crab potting area.

2. Migration of large sedimentary bedforms (temporal changes in bed type). The NE part of the crabbing area is located in an area described as a mega-ripple field, with the seabed facies thought to comprise sand with some gravel. The sandy bedforms present in this area, typically of a few meters in wavelength and a few decimeters in height, can migrate at rates of up to tens of meters per year. Therefore, it is likely that there will be a temporal change in the nature and topography of the seabed at any one point as mega-ripples move over the seabed. Sedimentary data also suggests that the local environment is erosional, or at least non-depositional, in the long-term. This suggests that there is unlikely to be a long-term tendency for sedimentation on the seabed (although some material could be entrained within the lower energy environment of a crab pot).

3. Change in the topography of the seabed. Of particular relevance to the crab fishery is the potential for the southern edge of the HSB to have been modified as a result of aggregate extraction. This in turn could affect the abundance of crabs in the area and/or disrupt the migratory pathway of crabs across the area.

4. Impact of sediment plumes. Dredging at HSB involves screening (the active screening of fine particles from the final load back into the water column). Therefore, sediment plumes are created by the extraction operations. Plume dispersion studies at HSB have been undertaken by independent consultants, the results of which indicate that in the immediate vicinity of the dredger, suspended sediment concentrations (SSC) may reach 100s of mg/l above background levels, but that about 50 meters from the dredger these levels are only predicted to be 50mg/l above background.

However, CEFAS feel that more work is required to explore potential pathways for sediment plumes to reach the crabbing area. It is proposed that a detailed acoustic survey with appropriate ground-truthing will help determine the potential sediment transport pathways and the nature of sediments passing through the area.

5. Wider oceanographic/bio-geographic changes. There has been little analysis of long term oceanographic or bio-geographic datasets to determine whether a potential mechanism exists from impacts upon this fishery through temperature shifts, changes in salinity regimes, or an increased abundance of non-native spider crabs (leading to competition for habitat between brown and spider crab).

6. Over-exploitation of crabs adjacent to HSB and in wider region. It is possible that over-exploitation of crabs, either locally or more widely in the eastern English Channel could have caused the observed changes in crab catch rates adjacent to the HSB. There is limited data on this potential mechanism at the moment and a major study into the crab population dynamics of this region would need to be undertaken to address this issue.

7. Noise disturbance from dredger activity. Dredging activity also generates noise and vibration, both from the vessels engines and also the noise of the draghead on the seafloor. Recent research by CEFAS[4] in the U.K. looked at the noise emissions of marine aggregate dredgers and related this to the sensitivity of certain fish species to noise effects. However, this report did not consider effects of noise on migratory crab; therefore, there is still uncertainty regarding this potential effect.

3.5.4.2 Chronology of Conflict Between Aggregate Extraction and the Brown Crab Fishery at HSB

Table 41 below summarizes the key stages of the conflict between aggregate dredging and the brown crab fishery at HSB, charting its progress since as far back as 1986.

[4] Preliminary investigation of the sensitivity of fish to sound generated by aggregate dredging and marine construction. Report by CEFAS on behalf of the Department of Environment, Food and Rural Affairs. Project Code AE0914. March 2003.

Table 41

Key Stages of Aggregate Dredging and Brown Crab Fishery Conflict at HSB

1986	The original application to extract aggregates from HSB was submitted to the Government for a decision in 1986. Right from the outset of the application process, local fishermen objected to this application, in particular Mr. Peter Storey who prosecuted the local brown crab fishery and local sole netsmen further inshore. Their main objection was the predicted adverse effect that aggregate extraction would have upon fish stocks in this area.
1987	Following consultation and an environmental assessment, a positive "Government View" was eventually granted (dated 10th May 1987) based on the scientific evidence provided by the Applicants and other stakeholders. However, the original Government View recognized the potential for conflict with the local brown crab fishery and so included a condition on the dredging license that requested, "*a further assessment of the likely impact on the crab fishery in the areas and a strategy for seasonal shifts of the dredging activity to minimize dredging impacts on the impacts on the crab fishery at the time and location of its greatest vulnerability*". The dredging was also limited to three areas (X, Y, and Z) well to the north of the crab fishery.
1989	Aggregate extraction commenced, with consideration to the crab fishery further south. Discrete dredge lanes were developed on the northern part of HSB (Zones X, Y, and Z), therefore, away from the main crab fishing area.
1989-1993	Records of catches kept by Mr. Storey were issued to the Ministry of Agriculture, Fisheries and Food (MAFF) for comment.
1993	Following complaints from Mr. Storey about the effect of the dredging on his catches, MAFF issue a letter stating that overall catch data do not appear to back up Mr. Storey's contention about dredging. MAFF suggested that if there is a detrimental local impact of dredging then it would show up with a greater decline in LPUE in strings closest to the dredging.
1995	MAFF suggests that any extension of dredging further south should only be permitted after all resources in the northern part of HSB are exhausted.
1995	Following submission of an EIS to the government and extensive consultation, a positive Government View is granted to the dredging companies to extend their dredging activity further south within the HSB area, i.e. closer to the crab fishery.
	As part of the license conditions for the new renewal license, a monitoring program using sentinel strings set in potential impact areas and control areas is started. Catches on sentinel strings logged by Emu staff during three sea days per month over the main fishing season (August to October).
1996	An application submitted by the dredging companies to extract aggregates from "Hastings South," an area that overlaps with Mr. Storey's actual fishing grounds.
1997	A letter was issued by Mr. Storey to the dredging companies claiming that the deposition of fine sediments from the dredging activity had resulted in reduced catches along the edge of the HSB (where his main fishery is located). The letter also raises issues of proposed extension of license area to the south, right into his actual fishing area.
	A meeting was held in London between fishing interests, dredging companies and the Government. Concern raised by government officials about the potential plume effects of dredging on HSB affecting the brown crab fishery.

Table 41

Key Stages of Aggregate Dredging and Brown Crab Fishery Conflict at HSB (con't).

1998	Further meetings were held and the possibility discussed of including physical monitoring work in this area, such as subsea video surveys. It was also decided that the historic data from Mr. Storey's personal fishing log-book be provided to independent consultants and analyzed to describe long-term trends.
1999	New environmental work was undertaken by dredging companies in order to support the application for South Hastings. A plume dispersion study was produced by Hydraulics Research (HR) Wallingford which assessed the distribution of the sediment plume produced by dredging activity. This study was used to support the EIS submitted to the Government for a renewal of the license on HSB and a new license at South Hastings.
	The Centre for the Environment, Fisheries and Aquaculture Science (CEFAS), an executive agency of the Government, produce a report that states "*it can no longer be said that despite dredging at Shingle Bank there has been no change to the crab fishery further south*".
2000	Emu Ltd (consultants to the Dredging Companies) submit a response to a summary report prepared by Mr. Storey that debates one of the key issues raised by Mr. Storey, namely that the tidal direction used in HR Wallingford models is incorrect.
	CEFAS deploy logger-pots in the HSB area and undertake oceanographic measurements. Results indicate that the actual tidal angle in the fishing area is closer to that stated by Mr. Storey than that used in the HR Wallingford models.
2001	HSB license renewal (No. 3) granted by Government.
2004	Detailed report issued by CEFAS entitled "*Trends in the Hastings Shingle Bank crab fishery, 1985-2003, in relation to gravel extraction at Shingle Bank*". The report stated that there had been a step change in LPUE (a reduction) following the start of dredging but that this step change had also been observed in the control area. It concluded that there was no way of saying with 100% confidence that dredging was the cause of any reduction in the crab fishery in this area.
2005	Application by the dredging companies for a license at Area 460 (South Hastings). EIS process is underway and is due to be submitted 2006.

Source: Resource Management Association, *Pers. Comm.*, 2005

From Table 41 (above) it is clear that a well-established history of conflict exists on the HSB between the key brown crab fishery and dredging activity. Based on the various conflict types listed in the preliminary desk review undertaken as part of this study, the following conflicts ascertained to exist on this site are described in Table 42 below.

Table 42

Types of Conflict on the Brown Crab Fishery Present at the HSB Case Study Site

Type of Reported Impact/Conflict	Specific Impact	Relevance at HSB site
Direct Impacts on Commercial and Recreational Fishing Activity	Reduction in Catches/Landings	Scientific data from the sentinel strings and vessel log-book data demonstrate a reduction in catches in 1991, two years after the start of dredging in this area.
	Exclusion from fishing grounds	Whilst not yet an issue, the recent application to move into Area 460 (South Hastings) will result in direct competition between the dredgers and the fishermen in this area.
	Economic impacts	The reduction in catches claimed by local fishermen has manifested itself in an economic impact upon his operations.
Indirect Impacts on Commercial and Recreational Fishing Activity (via Ecological Impacts)	Damage to fish ecology (breeding, spawning, feeding)	The key ecological impact on this area is claimed to be deposition of fine sediments onto a previously "clean" area of seabed that provided a migration pathway for adult crabs. This has either reduced the overall amount of crabs moving through this area or has deflected these crabs further south, outside the range of the local fisherman.
	Loss/Damage to fish stocks	
	Water quality affecting fish	
	Physical changes to the seabed	
	Cumulative effects	Dredging has been undertaken in this area since 1989 and it is claimed that it is the cumulative effect of this activity that has resulted in the "step-change" noted in the monitoring and log-book data.

Source: Emu Ltd, 1999.

3.5.4.3 Conflicts Between the Sole Fishery and Marine Aggregate Extraction

The Hastings fleet, engaged in the set net fishery for sole, alleges that since dredging commenced on the HSB during 1989, sole migration has declined across the traditional migratory pathway, resulting in a significant decrease in catches for the inshore set net fishery.

Based on meetings with local fishermen, it is estimated that before dredging began in this area, the sole stock was around 16,000 tons but since dredging has been undertaken, this has reduced to only 2,000 tons.

The vulnerability of the sole to effects from dredging operations on the HSB is alleged to come from the well-defined migratory pathway across the HSB, before the sole disperse into the inshore area. Potential mechanisms by which impacts of this dredging may arise upon these migrating sole are summarized below.

1. Change in nature of the seabed. Dredging at HSB has resulted in a change in the nature of the seabed in this area, from predominantly a stable gravel sediment to one with a higher proportion of mobile sands (created by actively over-spilling sand during extraction operations). Research data and data from commercial fishermen seem to indicate that the migration of sole inshore and offshore is tidally assisted, with sole swimming actively on favorable tides but settling out to the seafloor when tidal streams are less suitable. Therefore, there is the potential that any alteration of the nature of the seabed may impact upon migrating sole when they are in their "resting phase" on the seabed.

2. Loss of benthic fauna (prey items). Dredging has also resulted in the loss of benthic fauna in the areas affected, with close to 100 percent reduction in species diversity, abundance and biomass noted in areas subject to continuous dredging activity. Therefore, in these areas, potential prey items for sole will be absent. However, in terms of the effect this will have on the main sole migration (on which this fishery is based), this is judged to be negligible as research indicates that all sole show a marked decrease in feeding rates during their rapid inshore migrations, suggesting that feeding is not important during this migratory pre-spawning phase.

3. Change in the topography of the seabed. Dredging has altered the topography of the seabed in the licensed extraction area, with some areas lowered by up to eight meters (26 feet) since dredging began. There is currently insufficient evidence on the potential effect these changes in local seabed topography have had on sole migration through this area.

4. Impact of sediment plumes. Dredging at HSB involves screening (the active screening of fine particles from the final load back into the water column). Therefore, sediment plumes are created by the extraction operations. Plume dispersion studies at HSB have been undertaken by independent consultants, the results of which indicate that in the immediate vicinity of the dredger, suspended sediment concentrations (SSC) may reach 100s of mg/l above background levels, but that about 50 meters (164 feet) from the dredger these levels are only predicted to be 50mg/l above background.

5. Noise disturbance from dredger activity. Dredging activity also generates noise and vibration, both from the vessels engines and also the noise of the draghead on the seafloor. Recent research by CEFAS[5] in the U.K. looked at the noise emissions of marine aggregate dredgers and related this to the sensitivity of certain fish species to noise effects. Actual noise measurements were taken 50m from an active aggregate dredger whilst it was conducting full dredging activities. The results indicated that the noise generated was below the levels that will cause permanent or temporary loss of hearing and that flatfish (such as sole) were less sensitive to acoustic stimuli than species such as herring.

However, the report went on to make direct reference to the HSB dredging operation, stating that although the noise generated here was unlikely to cause damage to fish, it may be sufficient to cause behavioral changes, e.g., modification of migratory pathways.

Table 43 below summarizes the types of reported conflict on the sole fishery present at the HSB case study site.

[5] Preliminary investigation of the sensitivity of fish to sound generated by aggregate dredging and marine construction. Report by CEFAS on behalf of the Department of Environment, Food and Rural Affairs. Project Code AE0914. March 2003.

Table 43

Types of Conflict on the Sole Fishery Present at the HSB Case Study Site

Type of Reported Impact/Conflict	Specific Impact	Relevance at HSB site
Direct Impacts on Commercial and Recreational Fishing Activity	Reduction in Catches and Landings	Local fishermen claim that since dredging began, the inshore migration of sole over HSB has been affected, resulting in reduced catches for the inshore set net fishery.
	Economic impacts	The reduction in catches claimed by local fishermen has manifested itself in economic impacts upon their operations.
Indirect Impacts on Commercial and Recreational Fishing Activity (via Ecological Impacts)	Damage to fish ecology (breeding, spawning, feeding)	The potential mechanisms for impacts upon these migrating sole are listed above and include changes to seabed composition, changes in seabed topography, sediment plumes, loss of potential food items, and noise.
	Loss/Damage to fish stocks	
	Water quality affecting fish	
	Physical changes to the seabed	
	Cumulative effects	Dredging has been undertaken in this area since 1989 and it is claimed that the cumulative effect of this activity is continuing to cause a reduction in sole catches inshore.

Source: Emu Ltd, 1999

The conflict types that exist on the sole fishery in this area are the same as those for the brown crab fishery, apart from there is no exclusion from fishing grounds for the sole fishery in this area as it is concentrated inshore of the main dredging area.

4.0 COMPARISON OF US AND U.K. MITIGATION MEASURES FOR REDUCING IMPACT BETWEEN AGGREGATE EXTRACTION AND FISHING ACTIVITY

A review of the above U.S. and U.K. case studies reveals a number of key findings and observations. The relevance of these findings is clear when considered in tandem with mitigation measures designed to alleviate impacts on fisheries. This section reviews and compares the various mitigation measures used in both the U.S. and the U.K. Such a comparison is designed to contribute to the discussion of recommendations detailed in Section 5 below.

4.1 U.K. Dredging/Operational-Based Measures

Since dredging has been undertaken at HSB, every license issued to the dredging companies has included a set of conditions which detail the mitigation and monitoring measures that the license holders are required to undertake. If these measures are not adopted or the monitoring not undertaken, then the issuing body (currently the Department for Communities and Local Government) has the powers to revoke or halt the license.

Specific measures related to fisheries set out in the License Conditions for the 2001 license renewal are summarized below.

- During the license, the Licensees shall liaise with fishermen on matters of access routes to the dredging areas and on buoying arrangements. Access to and from the dredging areas shall be from the south. A weekly program of operations shall be forwarded to the fishermen's liaison officer.

- No more than two dredgers shall operate within the licensed block at any time.

- The Licensees shall continue the scheme agreed between the Dredging Companies, the Crown Estate Commissioners and local fishermen, by which damage to fishing gear outside the Licensed Block and consequent loss of earnings may be investigated and the costs may be estimated and cases adjudicated and compensation paid[6].

- Compensation[7] will also be paid for damage to fishing gear within the License Block if the dredgers had not given proper notice to fishermen of their intention to dredge.

- The Licensees shall not dredge in Lane 9B from August to November in order to protect the local brown crab fishery.

- In order to minimize any possible effect on the sole fishery, the Licensees shall cease dredging for an annual period of 10 weeks. The period shall start between approximately mid-February and mid-March in each year. The precise start date shall be notified to the Consortium by the Hastings Fishermen's Protection Society giving seven day's notice.

As well as setting out detailed mitigation measures, the license conditions for marine aggregate sites in U.K. waters also include detailed monitoring plans for that site, usually for a five-year period, following which a formal review of all monitoring data is carried out and the monitoring program amended where appropriate. It is important to note that monitoring on its own does not represent mitigation: monitoring only acts as mitigation if the results are used in a scheme of adaptive management that allows for modification of dredging practices shown to cause significant impacts.

[6] As a result of EMS aboard dredgers, there have been no incidences of out of area dredging; therefore, no compensation has been paid.

[7] Compensation Committee consists of Sussex Sea Fisheries Committee, the Liaison Skipper, 2 representatives of the Dredging Consortium, the Marine Fisheries Agency District Inspector and a member of the National Federation of Fishermens Organisations (NFFO).

On the HSB license area, monitoring is carried out for a range of parameters, including fisheries. With respect to fisheries, the following monitoring is currently carried out as part of the license conditions (Table 44).

Table 44

Fisheries Monitoring Measures in Existing Dredging License Conditions

- The Licensees shall make or cause to be made surveys of sole to a specification to be determined in conjunction with CEFAS. The results shall be made available at least two months before, and reviewed, at the Annual Review Meeting;
- The Licensees shall make or cause to be made monitoring of crabs to a specification to be determined in conjunction with CEFAS. The results shall be made available at least 2 months before, and reviewed, at the Annual Review Meeting;
- The Licensees shall make or cause to be made the collection and analysis of monthly catch data on sole to a specification to be determined in conjunction with CEFAS. These data should be reviewed at the Annual Review Meeting.

Source: Resource Management Association, *Pers. Comm*., 2005.

4.2 U.S. Dredging/Operational Based Measures

For U.S. dredge companies, commercial and recreational traffic is one of the largest concerns each project faces. Because safety is paramount for dredge operators, extra caution must be used when operating equipment in areas where high fishing traffic occurs.

Vessels are bound by all Coast Guard regulations and dredge vessels are inspected by both the Coast Guard and American Bureau of Shipping. All officers on each dredge vessel are required to hold applicable licenses, and captains must hold Unlimited Master's Licenses.

The number of regulations that dredge operators must follow are numerous, ranging from regulations related to specific lighting requirements for dredging operations to those related to monitoring VHF radio channels for communication, both of which are mandated by the U.S. Coast Guard. Unlike measures in the U.K. case, however, which are directly related to fisheries, dredge operators in the U.S. follow general regulations aimed at protecting all user-groups in the shared waters and not fishermen specifically.

Although there are few engineering options available to dredge operators to prevent or minimize conflict with fishing vessels, dredge companies are bound to perform the contract within the specifications and corresponding permits. One dredge operator explains that, "Normally there is little leeway to deviate from the contract" (Goddes, oral commun., 2006). Such standardized procedures include publication of the dredge operation in the *USCG Notice to Mariners*, with regular updates.

In the case of Collier County, the dredge company in charge exceeded expected measures to mitigate conflict by: (1) making direct contact with the local crab and fisherman's group; (2) providing information about the work schedule, the work area, and the method of work; and (3) providing a notice to "steer clear" of the operation and transit routes during navigation and remove crab pots, if necessary. Specific coordinates of the work areas were also provided, along with frequent updates posted in the local newspaper and local marinas.

4.3 Fisherman-initiated Mitigation Measures

The fishing industry is unique from other industries, largely because it is highly susceptible to changes in the physical, natural, social, and economic environments. It relies heavily upon the well-being of particular species of fish and seafood and of its ecosystem; it must respond to changes in location and quality of species habitat; it is vulnerable to weather changes; it must respond to changes in traffic and occasional increases in competition for fishing grounds and waterways; and it must adapt to changes in global economies that affect local prices of fuel and other marine-services. Moreover, it is an industry in which workers spend long hours away from land and are primarily concerned with making a living. Their principle means of communication are via VHF radio or face-to-face conversations with fellow fishermen. Although increasing regulations set by NMFS has heightened the wariness that fishermen display of the federal government in general, they are open to discussion and flexible in accommodating requests.

In the Brevard County study, it was noted that commercial fishermen had neither large amounts of disposable time nor income, and were largely transient. These factors contributed to the lack of professional organization and, therefore, the lack of a body that could serve as a discussion and decision-making forum. Charter fishermen, by contrast, were defined through a well-established association that had a wide membership which frequently assembled to network and discuss local issues affecting the charter fleet. Often charter fishermen acted on and abided by decisions made through the association. Therefore, any potential mitigation measures deemed necessary by this group likely would have been discussed and initiated through this association, and not by commercial fishermen. That is, fishermen-initiated measures are more likely to take shape where an established body for assembly is found among fishermen.

4.4 Government-initiated Mitigation Measures

4.4.1 U.K. Initiatives and Actions

Current specific policy guidance with respect to marine aggregate extraction is set out in the Marine Minerals Guidance Note 1 (MMG1): Guidance on the Extraction by Dredging of Sand, Gravel and other Minerals from the English Seabed (ODPM, 2002) (although a new statutory system with new guidance is currently out for consultation).

MMG1 highlights the need to minimize the potential impacts of marine aggregate extraction by identifying appropriate mitigation measures where potential concerns have been identified. Generic mitigation measures are actually listed within MMG1 and are often simply used, word-for-word, within site-specific Environmental Impact Statements. U.K. mitigation measures to avoid, reduce, or remedy significance adverse effects as set out in MMG 1 have built-in initiatives and actions toward protecting fishing interests. For example, MMG1 suggests that the following measures be adopted in order to minimize the impacts of dredging activities:

- Modification of the dredging depth to limit changes to hydrodynamics and sediment transport patterns to acceptable levels;
- Agreed dredger navigation routes to minimize interference with fishing, fishing and other uses of the sea;
- Zoning of the permitted area to protect sensitive fisheries, optimize access to traditional fisheries and to reduce the impact on sensitive benthic assemblages;
- Exclusion zones to protect rare or stable communities identified as occurring in small areas within a much larger application area. Such exclusion zones also provide a refuge for species that may assist in the eventual re-colonization of the worked-out area. Where such an approach is considered appropriate, it is important that the exclusion zones are large enough to protect the area of critical importance;
- The choice of dredging technique and the timing and phasing of working may also assist in preventing disturbance. For example, it may be appropriate to allow dredging only at particular stages of the tide to ensure that disturbed sediments are transported away from exclusion zones by the tide, or to prohibit screening;

- Seasonal restrictions, where appropriate, to minimize impacts on migratory fish stocks or on vulnerable life history stages of fish or the benthos;
- Safety buffer zones around war graves, important wrecks or other marine archaeological sites, pipelines and cables.

Similarly, the International Council for the Exploration of the Seas (ICES) has also published 1992 guidelines for the management of marine sediment extraction which sets out high-level mitigation measures. They include the following:

- The selection of aggregate dredging equipment and timing of aggregate dredging operations to limit impact upon the biota (such as birds, benthic communities, any particularly sensitive species and habitats, and fish resources;
- Modification of the depth and design of aggregate dredging operations to limit changes to hydrodynamics and sediment transport and to minimize the effects on fishing;
- Spatial and temporal zoning of the area to be authorized for extraction or scheduling extraction to protect sensitive fisheries or to respect access to traditional fisheries;
- Preventing on-board screening or minimizing material passing through spillways when outside the dredging area to reduce the spread of the sediment plume;
- Agreeing on exclusion areas to provide refuges for important habitats or species, or other sensitive areas.

As can be noted from points listed above, the generic mitigation listed in relevant policy guidance and international (ICES) guidelines includes measures specifically designed to minimize impacts upon commercial fisheries and fish resources. In addition to these high-level mitigation measures, a series of mitigation measures specific to fish resources and commercial fisheries have also been developed over the years by the U.K. marine aggregates and fishing industries.

4.4.2 U.S. Initiatives and Actions

U.S. federal agencies also abide by a set of mitigation measures or laws to avoid, reduce, or remedy significant adverse effects to fisheries. For example, the Magnuson-Stevens Fishery Conservation and Management Act (MSA;16 U.S.C. 1855[b]) provides, through §305(b), for required consultation between federal agencies and the Secretary of the Interior on all actions, real or proposed, undertaken, authorized, or funded by the agency that may affect essential fish habitat (EFH). Such consultation should end in the Secretary's provision of recommendations, including "measures to avoid, minimize, mitigate or otherwise offset adverse effects on EFH," in order to "conserve EFH to federal or state agencies for activities that would adversely affect EFH" (National Marine Fisheries Service, 2004, p. ii). Finally, the consultation requires that the Federal agency provide NOAA Fisheries, NMFS, and "any Council commenting under §305(b)(3)" a written "detailed response" within 30 days after receiving an EFH Conservation Recommendation. Although there are no set criteria for EFH consultation, federal agencies follow existing environmental review procedures as "the primary mechanism" for such consultation, which have been supplemented with a general set of guidelines established by NOAA for addressing EFH coordination and consultation (National Marine Fisheries Service, 2004, p. ii).

Mitigation measures are achieved also through specific actions and requirements undertaken by individual federal agencies, though these may or may not include fisheries-related concerns. The USACE, for example, requires a benefit-cost model or analysis for all federally-funded beach nourishment projects. Such an analysis compares all relevant benefits from beach nourishment projects to all relevant costs. According to NOAA (2002), "Benefits include the estimated storm damage reduction and recreational benefits. Costs include the expected costs of construction, the present value of periodic maintenance, and any external costs such as environmental costs associated with mitigation." Benefits must out-weigh costs in order for a project to be accepted. Methods used to perform a benefit-cost analysis (e.g., market pricing, beach modeling, travel-cost method) tend to treat ongoing beach nourishment in a traditional economic manner, viewing more purely as a capital investment problem (NOAA, 2002).

At the same time, however, the USACE has come to recognize the importance of multiple stakeholder representation. One measure it uses to mitigate negative impacts is what is termed as "water project planning". According to USACE,

> Water project planning has evolved toward a more collaborative venture, giving voice to many stakeholders representing the diverse objectives that water projects can address. Successful water project planning and evaluation in a multi-objective, multi-stakeholder environment requires an integrated systems approach capable of a balanced evaluation of all relevant issues (e.g., hydrologic, geomorphic, ecologic, social, and economic) over relevant scales of space and time. Such an approach is required to identify unintended impacts (USACE, 2004, p. 1).

The National Environmental Policy Act (NEPA) is the federal mandate governing all U.S. government initiatives and actions toward mitigating potential and real conflict between beach nourishment and the general public, including fishing communities. With the exclusion of Congress and the President, all federal government projects must adhere to NEPA requirements, including the development of EISs and EAs, for action. U.S. federal government adherence to NEPA is not unlike U.K. government adherence to the Interim Governmental View Procedure (IGVP).

NEPA is one legal mandate governing decision-making undertaken by MMS; the Outer Continental Shelf Lands Act Amendments (OCSLA) of 1978 is the other. Both laws require MMS to study the human environment, providing guidance on social science research that helps uncover consequences of OCS projects on populations, economies, and social and cultural systems in related areas. According to MMS,

> Social and economic effects can occur at all stages of OCS development, from prior to a lease sale, through exploration, development and production, to decommissioning and the cessation of activities. The possible social and economic effects of the program are among those of greatest concern to the public and to Federal, state and local government officials. Analysis of these dimensions can provide a better understanding of how future long-term impacts will affect communities and ways of life and will allow for predictions of these impacts. In addition, this information allows the decision maker to discuss the likely impacts of development in terms (e.g., jobs, income, public services, subsistence resources, etc.) familiar to the public, thereby allowing the public to examine the project in terms relevant to their own communities and lives (MMS, 2006c).

A number of problems have been associated with NEPA requirements, problems that result in EAs and EISs that overlook broader social and cultural issues (see e.g., National Preservation Institute [NPI], 2006). For example, there have been issues associated with poor scoping; use of a multidisciplinary as opposed to an interdisciplinary approach; and deferral of an issue. "Scoping," or "figuring out what the scope of the EIS should be" is affected through a limited procedure of determining the scope (e.g., holding a public meeting only) or through proceeding according to what analysts are capable of analyzing (NPI, 2006). Analysis performed by practitioners of different disciplines in isolation from one another, rather than in an integrated approach among disciplines, and deferral of an analysis, either temporarily or permanently, also may cause cultural and social resources to be overlooked.

MMS has given significant attention to applied social science measures in OCS activities; yet it has given little direct attention to needs and concerns of fisheries within the specific context of offshore aggregate extraction. MMS's Negotiated Noncompetitive Lease for Sand, Gravel and Shell Resources on the Outer Continental Shelf awarded to Collier County, Board of County Commissioners, Florida provides stipulations drawn from NEPA work. The majority of the stipulations relate to the endangerment, reporting, and relocating of sea turtles and/or their nests. At the same time, however, they overlook the interests of a broader set of stakeholders.

4.5 Comparing Cases Internationally

Interaction between fisheries and the dredge industry varies from location to location. It can also vary within a given state as much as it can between countries. Comparison between the HSB case study in the U.K. and the U.S. case studies in Brevard and Collier Counties reveal a number of important similarities and differences (Tables 45 and 46). In terms of similarities, EISs or EAs are required by both governments. The inclusion of Environmental Statements in both cases points to the provisions both the U.S. and the U.K. have for safeguarding the environment, including the human environment.

Table 45

Similarities and Differences between U.K. and U.S. Cases

KEY SIMILARITIES	
Type of Reported Similarity	**Relevance**
Regulations	In both the U.K. and the U.S., there is governmental jurisdiction over offshore waters. Also, there is inclusion of ES/EIS under the IGVP (U.K.) and NEPA (US).
KEY DIFFERENCES	
Type of Reported Difference	**Relevance**
Duration of dredge operations: extensive in U.K., less extensive in U.S.	With its longer history of dredging relative to the U.S., the U.K. has a longer history of documented conflict between fishermen and dredge operations. Therefore, there is more consideration of potential conflict in existing U.K. policy, relative to the U.S.
Inclusion of fishing interests in formalized mitigation measures in U.K. versus oversight of fishing interests in formalized mitigation measures in U.S.	Inclusion creates greater awareness of real or potential issues at hand and assists in leveling the playing field with respect to communication with fishermen and promotes participation.

Table 46

Direct and Indirect Impacts on Commercial and Recreational Fishing Activities
in the U.K. and U.S. Cases

Direct Impacts on Commercial and Recreational Fishing Activity	Exclusion from and increased competition for space in fishing grounds	Although not an issue in the HSB, the recent application to move into Area 460 (South Hastings) may result in competition for water space. In contrast, Collier County dredge operators and fishermen sometimes compete for water space. Crabbers are pushed to remove traps in the vicinity of the dredge operation so as to prevent a severing of buoy lines and loss of traps.
	Reduction in Catches/Landings	Scientific data from the sentinel strings and vessel log-book data in the U.K. demonstrate a reduction in catches in 1991, two years after the start of dredging in this area. No scientific data have been drawn from the U.S. cases, but Collier County crabbers have had smaller catches due to loss of traps.
Indirect Impacts on Commercial and Recreational Fishing Activity (via Ecological Impacts)	Economic impacts	The reduction in catch claimed by both U.K. and U.S. fishermen has manifested itself in an economic impact upon operations and individual livelihoods.
	Damage to fish ecology (breeding, spawning, feeding) through blanketing of sensitive areas	In the U.K., there reportedly is a deposition of fine sediments onto a previously "clean" area of seabed that provided a migration pathway for adult crabs. This has either reduced the overall amount of crabs moving through this area or has deflected these crabs further south, outside the range of the local fisherman. In the U.S., there is the *potential* deposition of fine sediments onto the outer reefs of Cape Canaveral, where bottom fish feed, and *potential* damage to black grouper spawning grounds off of Sanibel Island, Borrow Site TI.
	Water quality affecting fish	
	Physical changes to the seabed	Physical changes to the seabed in the U.K. lead to concerns about migration patterns and benthos. Potential changes in the seabed in the U.S., due to dredging, lead to concerns about tidal protection and loss of navigation routes.
	Cumulative effects	In the U.K., MAE activities have been going on in the HSB since 1989. The cumulative effects of this activity have resulted in the "step-change" noted in the monitoring and log-book data. In the U.S., dredging at the above-referenced sites is new, with no cumulative, "step-change" noted to date.

Such a comparison also reveals a number of differences. Most notably, there are significant differences in the histories of dredging and in use of aggregate materials, and the histories of recorded conflict between dredge operations and fisheries. The often annual dredging along the HSB, where sand mining occurs in short segments, but frequent intervals, contributes to a range of cumulative effects that can be empirically tracked.

In contrast, the dredging activities in the U.S. case sites are a new phenomenon, lasting only weeks or a few months. Therefore, any cumulative effects from sand mining in these areas are not yet visible or manifest.

A second major difference between the U.S. and the U.K. relates to the inclusion of fishing interests in formalized mitigation measures. As noted above, a number of mitigation measures designed to directly protect fishing interests have been built into U.K. governmental policy and U.K. dredging operation policy, e.g., license conditions. By contrast, while the U.S. has mitigation measures designed to involve the public, such as the public comment period built into the competitive leasing processes and the NEPA mandated consideration of impacts on human environments prior to approving an operation, little direct consideration is given to the impacts of dredging on human populations *during* the operation.

Exclusion from and increased competition for space in fishing grounds is documented in this report as greater within the U.S. cases than in the U.K. case. While exclusion has not yet been an issue at the HSB, the recent application to move into Area 460 (South Hastings), which is a common fishing ground, introduces the potential for conflict. In contrast, Collier County dredge operators and fishermen competed at times for water space. Crabbers were pushed to remove traps in the vicinity of the dredge operation so as to prevent a severing of buoy lines and loss of traps. Such exclusion mirrors exclusion from fishing grounds at other dredge sites in the U.S., most notably Boston Harbor (Berglane, 2005).

With regard to reduction in catches or landings, in particular, scientific data from sentinel strings and log-book data in the U.K. reveal that a reduction in landings has occurred since the start of the HSB. In the U.S., however, there are no studies measuring catch reduction as a result of sand mining. As a result, there is no objective data demonstrating catch reduction, despite the assertions of Collier County crabbers regarding reduced catch as a result of lost and damaged gear from dredging vessels. Such losses obviously have a direct economic effect for fishermen.

Although the particular issue of sediment deposition is still an on-going debate between fishermen and dredging companies, potential damage to fish ecology through the silting of sensitive areas was noted in both the U.K. and the U.S. In the U.K., there were well documented testimonies of indirect impacts from the creation of sediment plumes, including the deposition of fine sediment onto a previously "clean" area of seabed, and the subsequent disruption of crab migration. In the U.S. case studies, some fishermen believed that the silting of the outer reefs in the Canaveral area and the subsequent injury to juvenile fish habitats and spawning grounds was potentially due to dredge operations, but there was considerable debate between user-groups regarding this event. Without scientific studies on these particular sites, there is little way to confirm or dismiss these concerns.

In relating the difference in level and type of direct and indirect impacts between the U.S. case studies and the U.K. case study, a number of key factors associated with these differences become clear. These include:

- Key fisheries in area and seasonality;
- Spatialization of dredge operating in relation to fishing areas;
- Route and frequency of dredge equipment movement;
- Inclusion of consideration of impacts on fishermen in planning stages, including EIAs;
- Degree to which fishermen form a decision-making body;
- Level and frequency of communication between the county agency managing the dredge project, dredge company, dredge operators, and fishermen.

Ultimately, many of these differences can be attributed to the methods emphasized during data collection at each case site. In the U.K., methods largely consisted of desktop research and analysis, with a focus on impacts to fisheries that directly affect fishermen. In the U.S. cases, methods largely consisted of field research, conversations with industry and government figures, participant observation, and a literature review. The focus here was on both the actual and perceived impacts on fishermen in terms of their fisheries. Differences also result from the varying degrees and length of dredge operations between case studies, and the lack of cumulative effects at the U.S. study sites.

4.6 Key Issues

As cited in the literature on the effects of sand mining operations on fish resources, the most commonly considered impacts include:

(1) Seabed disturbance;
(2) Creation of sediment plumes;
(3) Noise emissions; and
(4) Chemical effects.

However, when considering the impacts of sand mining operations on fisheries and their human actors at the U.S. and U.K. study sites, several other less examined points of potential conflict emerge. These anthropogenic issues include: (1) restricted use of communication radio bands by fishermen; (2) loss of fishing gear; (3) changes to navigation routes; (4) changes to inshore currents and loss of protective barriers and (5) reduced access to fishing grounds. In part, these issues arise from the following limitations in U.S. policy regarding sand dredging:

(1) Lack of solid communication between fishermen, agencies, and dredge operators and lack of participation of fishermen in initial stages of data collection and planning.
(2) Oversight of fishing concerns in EISs and EAs.
(3) Lack of comprehensive social-science-based monitoring programs that examine ongoing interaction between stakeholders and cumulative effects.
(4) Limited use of institutional linkages.

(1) The lack of solid communication between fishermen, agencies, and dredge operators was observed in both the Brevard County and the Collier County cases. Although considerably fewer issues arose between fishermen and the dredge operation in Brevard County, fishermen in both counties were not generally included in the initial planning stages of the operation. In both Brevard County and Collier County, fishermen were told about the project and its related activities rather than enlisted as key stakeholders whose participation in the planning, implantation, and monitoring would be welcomed and valued.

In Collier County, lack of, poor, and miscommunication were at the root of several conflicts between fishermen and dredge operators. Although weekly public meetings were held by the Collier County government and attended by representatives from the Great Lakes Dock and Dredge, fishermen did not attend because they claim they were unaware of these meetings.

(2) Oversight of fishing concerns in the EISs and EAs occurs with frequency among federal government agencies. In part, such oversight stems from four main causes:

- an open definition of "Human Environment," as put forth in NEPA, which has resulted in narrow interpretation in EISs and EAs;
- the frequent use of EISs and EAs after a project has already started;
- no direct inclusion of fishing communities in definitions or, consequently, stipulations at the local, state, or national levels;
- the lack of close linkages between the multiple agencies that are involved in beach renourishment projects in the U.S. This lack contributes to the oversight of broader public concerns, including those of fishermen. The USACE, for example, has recognized that equal cost-sharing programs may contribute to oversight of broader scale concerns (USACE, 2004:3).

(3) Given these limitations, a monitoring program, that includes a social-science scope, is recommended to examine ongoing interaction between stakeholders and to observe cumulative effects. To date, no known monitoring program has been instituted in areas where marine aggregate extraction occurs in heavily fished waters.

In contrast, the license conditions for marine aggregate sites in U.K. waters set out detailed mitigation measures, and include detailed monitoring plans for that site, usually for a five-year period. After this five-year period, a formal review of all monitoring data is carried out and the monitoring program is amended where appropriate.

(4) Lastly, institutional linkages in dredge planning and execution in the U.S. are critically limited. Linkages currently exist between federal agencies, for example between MMS and USACE; between federal and state agencies, e.g., between MMS and FDEP; between state and local governments, e.g., between FDEP and Collier County; between federal and local government, e.g., between MMS and Collier County; and between local government and dredge companies, e.g., between Collier County and Great Lakes Dock and Dredge. Critically, however, rarely do linkages exist between three or more of these entities, as the U.S. cases reveal. Further, no such institutional linkage exists between any of these entities and fishermen or other stakeholders.

5.0 RECOMMENDATIONS

Comparisons between the U.K. study and U.S. study reveal key differences in approaches to mitigating effects between fishermen and officials (private, local government, state government, and federal government) involved in marine dredging projects. Based on the impacts and mitigation measures discussed in this report, we now offer several recommendations to address key concerns.

5.1 Potential Mitigation Measures to Reduce Impacts on Fish Resources

Four main sources of impacts to fish resources have been identified in the literature related to aggregate extraction. These include: the exposure of bedrock at dredging sites; noise generated by extraction; the creation of sediment plumes and the direct removal of spawning habitats, e.g., gravels used for spawning by herring.

A summary of the key mitigation measures that can be adopted to reduce these potential adverse effects are summarized below in Table 47.

Table 47

Summary of Proposed Specific Mitigation Measures Implemented to Reduce Impacts upon Fish Resources

IMPACT	MITIGATION
Dredging works will lead to a loss of benthic species resulting in reduced food availability for fish and shellfish (and decreased productivity)	Measures to reduce the impacts of aggregate extraction on benthic species include minimizing the area dredged, ensuring that at least 0.5 meters (about two feet) of sediment is left over all bedrock to permit recolonization and adopting zoning of dredge sites that leaves "buffer zones" that are not dredged and encourage recruitment into dredged areas. Any measures that reduce impacts upon the benthos will indirectly mitigate impacts upon fish resources.
Noise generated by extraction may impact on fish and shellfish	Potential noise effects on fish and shellfish are an unavoidable consequence of dredging activity and there are limited mitigation measures that can reduce this effect. However, the choice of dredge plant may influence noise emissions to a degree, as will minimizing loading times and, therefore, times on site. It is also important to note that the majority of mobile species will exhibit avoidance reactions, once noise levels reach limits that they find unacceptable.
Effects of sediment plumes (and deposition)	Where aggregations of particularly sensitive species are identified (e.g. spawning herring and sand-eel, over-wintering crabs), or dredging is planned in an area where discrete spawning migrations occur, i.e., sole on the HSB and black grouper on Borrow Site T1, screening strategies should be modified to reduce the level of suspended sediment concentration. In some instances, a complete temporary ban on dredging is implemented during the period that a particular species or life stage is most sensitive. Such restrictions are often termed "Environmental windows". In other instances, dredging along the tidal axis is implemented (see e.g., Murray, 1995)
Direct Loss of Key Spawning Habitat	As part of EIA studies, there is a requirement to identify any areas used for demersal, i.e., seabed spawning. Such areas include discrete gravel beds used for herring spawning. If any such areas exist within a dredging application area, then zoning of the license should be undertaken to avoid any dredging in these areas at any time, therefore avoiding the risk of these sensitive habitats being lost or irreversibly damaged.

Source: Posford Haskoning, 2002.

5.2 Potential Mitigation Measures to Reduce Impacts on Commercial and Recreational Fisheries

The potential for conflict between dredge operations and commercial and recreational fishing is high in certain U.S. waters–especially in waters with large in-shore invertebrate harvests. However, the opportunities to mitigate real and potential impacts are also plentiful. Currently a number of mitigation measures are present in both U.K. and European waters. These measures are well-suited for adaptation to U.S waters. Such measures include: seasonal restrictions, zoning of dredge operations, concerted efforts for a reduction in sediment plumes, and creation of formal liaison and consultation between dredging and fishing industries.

(1) Seasonal Restrictions. Seasonal restrictions on dredging are aimed at limiting the impacts on vulnerable life stages/species. For example, there is a restriction on an existing dredging license near Hastings, England, whereby dredging is not permitted during April and May in order that potential impacts on migrating sole are removed. To reduce the impact on herring spawning from another particular dredging license, it was recommended that no dredging takes place during the months of November to January inclusive and, as a precautionary measure, during April. Implementation of such measures in the U.S. would alleviate the potential for conflict between dredge operators and area fishermen who depend on access to their fishing grounds during their target species' season.

(2) ***Zoning of Dredging Operations.*** Zoning is the process whereby only specific parts of the licensed area are dredged at any one time, therefore allowing other marine users, such as commercial fishermen, greater access to licensed areas that are not currently being dredged. This mitigation measure has a number of benefits to fisheries, both in ecological terms and in exclusion/access terms.

In terms of reducing ecological impacts, minimizing the area over which dredging is undertaken in turn reduces the area of seabed affected. Zoning areas for dredging within the overall license area also enables dredging activities to be concentrated in one area at a time and will enable a dredged area to recover once the 'zone' is exhausted (the potential disadvantage of this measure is that zoning results in a higher intensity of dredging in certain areas. Recent research by Boyd *et al.* (2003) indicates that benthic impacts are greater, in terms of longer recovery rates, in areas subject to high intensity dredging).

With respect to the benefits of zoning to access for commercial and recreational fishing vessels, this measure reduces the area over which fishing activity is not permitted. Without such zoning measures, fishing could be prevented over entire licensed areas, even if dredging was actually only taking place in a small proportion of this total area.

To aid the practical implementation of this measure in U.K. waters, BMAPA and The Crown Estate produce active zoning charts which provide detailed information on the zoning of marine aggregate license areas located around the coastline of England and Wales. This bi-annual series of charts define the current active dredge area for eight separate regions and also contain the associated co-ordinates for each license area together with contact details for the operating companies. The active dredge area charts are available to be downloaded from the websites of both BMAPA (http://www.bmapa.org) and The Crown Estate (http://www.crownestate.co.uk) and copies are also distributed via the established dredging liaison committees on the South and East coast.

(3) Reduction in sediment plumes. Sediment plumes generated by marine dredging can directly (smothering of static gear) or indirectly (ecological impacts leading to reduced catches) impact commercial and recreational fisheries. There are a range of measures that may minimize these impacts. These include: (1) *Appropriate choice and operation of dredging plant:* this is fundamental in reducing the sediment plumes arising from aggregate dredging. Different mitigation measures are appropriate for different plant to reduce sediment re-suspension; (2) *Minimize Screening:* Where possible, minimizing screening will reduce the magnitude of the plume. Screening should be reported annually (on some license areas, screening is not permitted at all in order to protect sensitive resources); (3) *Dredge appropriate locations within licensed sites:* This measure involves targeting the resources to be extracted, to avoid areas with finer grain sizes. It is envisaged that this would be undertaken in most circumstances as a matter of course by dredging companies. Collation of data regarding sediment types within a license site will enable these areas to be avoided; (4) *Dredge parallel to peak tidal currents:* The tidal ellipse will be an important control on the area covered by the sediment plume. Dredging along a track parallel to the orientation of peak tidal currents will reduce the area covered by the sediment plume arising from the dredging. This measure is adopted in many cases as a matter of course by dredging companies as an operational requirement; and (5) *Dredged area to be minimized and worked to exhaustion:* Minimizing the area, which is being dredged, will act to reduce the area over which dredging will create a plume. The appropriateness of each of these measures to a particular application will depend on the nature of the environment at the site and the resources to be extracted.

(4) Formal liaison and consultation between dredging and fishing industries. For marine dredging in U.K. waters, a Code of Practice exists that sets out the need for and method of liaison between the fishing and marine aggregate dredging industries. For certain areas, dedicated Fisheries Liaison Officers are appointed to act as a point of contact between the dredging company and the local fishing industry. The appointment of this person has to be agreed by all parties.

All issues related to marine dredging and fisheries are typically discussed at these meetings, including perceived ecological impacts of the dredging on fish resources to formal complaints about damage or loss of gear. At recent meetings, the findings of government sponsored research into the effects of marine sand and gravel dredging have also been presented to the fishing community, in order to keep them informed of the most up-to-date research findings.

In addition to these measures, the coordinates of all new or modified dredging areas are always published in *Fishing News* (see Figure 34).

Fishing News is the most widely read commercial fishing newspaper in the U.K. and Ireland. Fishing News has been serving the fishing community for over 90 years. Each week it covers the latest news, reviews of new equipment and technology, vessels for sale, port reviews and boats on the move. Fishing News provides coverage to commercial fishing professionals throughout the U.K. It has a circulation of 8,739 and is the only weekly commercial fishing publication.

HANSON AGGREGATES MARINE LTD

PROPOSED EXTRACTION OF MARINE AGGREGATE FROM AREA 401/2 (GREAT YARMOUTH): RENEWAL OF EXISTING LICENSE

Notice is hereby given that Hanson Aggregates Marine Ltd (HAML) has applied for a Government View to dredge marine aggregate (sand and gravel) from Area 401/2, approximately 22km East of Great Yarmouth. The application is for the renewal of an existing license for this area which is set to expire on 31st March 2006. HAML wish to extract a maximum of 2 million tonnes per annum over a 15 year period.

Area 401/2 has two sub-areas, A and B and covers a total area of 50.96km2. The limits of the extraction area are defined by the following co-ordinates. Co-ordinates are in WGS84 – degrees decimal minutes to 4 decimal places.

Area 401/2 A

Co-ordinate Name	Latitude	Longitude
A1	002° 06.4229' E	52° 28.7738' N
A2	002° 05.9569' E	52° 28.7908' N
A3	002° 05.4570' E	52° 28.4408' N
A4	002° 04.9730' E	52° 28.4738' N
A5	002° 04.9570' E	52° 28.9238' N
A6	002° 04.7230' E	52° 29.0907' N
A7	002° 04.6070' E	52° 29.3737' N
A8	002° 04.4070' E	52° 29.6737' N
A9	002° 04.4730' E	52° 29.9407' N
A10	002° 04.9569' E	52° 30.2906' N
A11	002° 04.6900' E	52° 30.4736' N
A12	002° 03.3571' E	52° 30.5566' N
A13	002° 03.0901' E	52° 31.4235' N
A14	002° 05.5333' E	52° 32.4224' N
A15	002° 06.2472' E	52° 30.8570' N
A16	002° 06.6245' E	52° 30.9356' N
A17	002° 06.6408' E	52° 30.8826' N
A18	002° 07.1567' E	52° 30.9566' N
A19	002° 06.7067' E	52° 32.3235' N
A20	002° 06.8750' E	52° 32.2158' N
A21	002° 06.9206' E	52° 32.1260' N
A22	002° 07.4126' E	52° 32.1403' N
A23	002° 07.6829' E	52° 32.4508' N
A24	002° 07.6337' E	52° 32.5832' N
A25	002° 07.1291' E	52° 32.7429' N
A26	002° 06.8360' E	52° 32.9540' N
A27	002° 06.0179' E	52° 33.4375' N
A28	002° 06.0155' E	52° 32.7657' N
A29	002° 07.9673' E	52° 32.6980' N
A30	002° 06.6075' E	52° 32.7005' N
A31	002° 06.5951' E	52° 33.6721' N
A32	002° 10.1893' E	52° 34.3233' N
A33	002° 09.9894' E	52° 31.1906' N
A34	002° 09.7395' E	52° 28.7739' N
A35	002° 07.0898' E	52° 29.6237' N
A36	002° 07.1229' E	52° 26.5250' N
A37	002° 06.4899' E	52° 26.5250' N
A38	002° 06.5729' E	52° 27.3909' N
A39	002° 06.3069' E	52° 27.6909' N
A40	002° 06.0899' E	52° 28.2408' N

Area 401/2 B

Co-ordinate Name	Latitude	Longitude
B1	002° 04.2041' E	52° 27.7879' N
B2	002° 05.7230' E	52° 27.7909' N
B3	002° 06.0070' E	52° 27.4239' N
B4	002° 05.1571' E	52° 27.0409' N
B5	002° 05.1401' E	52° 26.5250' N
B6	002° 04.5901' E	52° 26.5250' N

An Environmental Statement and associated Coastal Impact Study have been lodged with the following organisations.

Great Yarmouth Borough Council
Planning and Development
Department
Town Hall
Hall Plain
Great Yarmouth
NR30 2QF

Norfolk County Council
County Hall
Martineau Lane
Norwich
NR1 2DH

Suffolk County Council
Planning and Development
Control
Endeavour House
Russell Road
Ipswich, Suffolk
IP1 2BX

The application will be considered by the Office of the Deputy Prime Minister (ODPM) under the Government View procedure. A favourable Government View will enable the Companies to apply to the Crown Estate for a Production Licence.
If you have any comments about the application you are invited to send these in writing to HAML c/o Emu Ltd, 1 Mill Court, The Sawmills, Durley, Southampton, Hampshire, SO32 2EJ to be received not later than 10 weeks from the date of this advertisement.

Copies of the Environmental Statement and Coastal Impact Study (at a cost of £20 for paper copies, or £5.00 for copies on CD) can be obtained from Emu Ltd at the above address, as long as stocks last. Copies of the Non-Technical Summary are also available (free of charge).

Figure 34. Notice of Publication of Environmental Statement and Supporting Studies in support of Area 401/2 Dredging License Renewal Application, as it appeared in Fishing News (Source: Fishing News, 2005).

(5) No exposure of bedrock. MMG1 includes a condition that no areas of bedrock should be exposed and that at least 0.5m of sediment should be left over any such areas. This is predominantly designed to ensure that there is suitable substrate left for the re-colonization of dredged areas by benthic species. However, this measure also acts as mitigation against the potential exposure of "fasteners" which may create adverse impacts upon trawling activity.

(6) Broadcasting of dredging vessels movement. The majority of licenses granted for the extraction of marine sand and gravel in the U.K. include a set of conditions designed to minimize impacts on all marine users. These conditions typically include one designed to minimize the risk of damage to gear and exclusion from fishing grounds. This involves the Master of any dredger working in an area contacting local fishermen to advise of operations and inform fishermen of imminent arrival on site within 10 miles of site, providing an estimation of arrival time and exact location of dredging (using GPS). This should provide any fishermen in the area with enough time to remove any gears currently being fished.

In areas where there is the potential for conflict to arise between dredgers wishing to access licensed sites and commercial fishing activity, a further mitigation measure that can be adopted is the creation of defined access routes to and from the license area, the position of which are then communicated to local fishermen. However, this is not a generic requirement and is only relevant under certain scenarios.

Applied to the U.S., broadcasting of vessel movement through fishermen-accessed radio channels should pose limited conflict with fishermen, but as the Collier County case shows, there is a need to broadcast all vessel and equipment movement, including pipeline, tugs, and scows within the use area, not only at the dredge site. This requires, however, an adherence to the said navigation route by dredge operators and, possibly, monitoring measures.

A number of additional potential mitigation measures for use in U.S. waters also apply. These are based on direct observation of the Brevard and Collier Counties study. They include:

- Designating communication channels on radio;
- Compensation for loss of fishing gear;
- Charting of navigation routes used by fishermen prior to operation;
- Communication with fishermen about changes to inshore currents and loss of protective barriers, whether potential or actual.

(7) Designated communication channels on radio. The conflict that occurred during the 2006 dredge project in Collier County over the use of VHF radio channels could potentially be resolved through the designation of communication channels prior to the onset of dredging activity. Although this conflict appears as unique to the incidences in Collier County, it is a conflict that could potentially occur in other small regions.

(8) Compensation measures for loss of fishing gear. The Fishermen's Contingency Fund of 1980, established through Title IV of the OCSLA, as amended (43 U.S.C. 1841-1846) and published (50 CFR 296), compensates commercial fishermen, up to $2 million, for actual and consequential damages including loss of profit due to damage or loss of fishing gear by oil and gas exploration, development, and production. The application of this same funding type to activities associated with marine aggregate dredging, by MMS, could supply a safeguard for action potentially taken by commercial fishermen in the event of loss of equipment.

(9) Charting of navigation routes used by fishermen prior to operation. The charting of navigation routes used by fishermen prior to dredging helps to inform a decision as to whether mining should proceed the same surface area in the same location on the borrow site) or whether mining should be altered. The degree of use of a navigation route should be weighed against the proximity of alternate routes and the economic costs associated with use of alternate routes.

(10) Communication with fishermen about changes to inshore currents and loss of protective barriers, whether potential or actual. Changes to inshore currents and wave conditions have received considerable attention in the literature on dredging, though not related to fisheries or the fishing industry. Although studies show that wave change is minimal, with a maximum change being 5 percent of existing conditions (Byrnes et al., 1999), concerns may be perpetuated in fishing communities. As identified in the literature, communication with fishermen about risks associated with dredging is recommended as "good rapport between operators can often minimize conflicts" (Murray 1995).

The aforementioned mitigation measures (1-10) refer to hands-on strategies aimed at directly lessening conflict between dredging and fishing industries. Indirect, though effective, measures also exist through policy. Potential policy-based mitigation measures that could be applied to U.S. sites are listed below in Table 48.

Table 48

Mitigation Measures through Policy

Increased public participation and open planning	Promoting public participation in local beach renourishment policy and planning processes, with specific consideration and involvement of user-groups, such as commercial fishermen, that do not operate through an official decision-making body.
Inclusion of fishing concerns in EIS/EA	Greater understanding of fishing environment and concerns through inclusion of fisheries analysis during EIS and EA phases.
Monitoring Programs	Monitoring programs designed to examine dredging activity as it occurs and to examine impacts on the physical and human environment, both immediate and cumulative.
Institutional Linkages	Creating institutional linkages for facilitating future cooperation between fisheries, MMS, and the dredging industry.

Source: Posford Haskoning, 2002; ODPM, 2002.

(1) Increased Public Participation. The role of public participation and open planning are critical in neutralizing social and economic impacts among all stakeholders. Because such participation can slow planning processes through comment by diversified groups, as is revealed by competitive versus non-competitive leasing procedures, it is often overstepped. Yet, according to the Marine Board, "Recognizing that beach nourishment is complex and controversial and that public support is essential, an open planning and implementation process is an important way to ensure that all pertinent interests and concerns are identified and addressed by decision makers" (Marine Board, 1995, p. 29).

Over the years, it has become apparent that greater involvement of fishermen in all stages of the project can facilitate understanding of fishing interests and concerns, including the placement of equipment, seasonality of work, and special needs, such as sufficient space and time for stopping or turning vessels (e.g., shrimping vessels). There must be an active relationship between community action and the presence of various interest groups, including fishermen and fishing organizations.

However, involving fishermen in discussions is frequently overlooked in the U.S., as noted in the two case studies presented here and in other reports and workshops (e.g., Fisheries and Oceans Canada, 2004; Pitcher and Chuenpagdee, 1993; and NOAA, No date). For example in the case of fishery mismanagement, Pitcher and Chuenpagdee state:

> [F]ishermen's interests are not explicitly included in the evaluation of responses to new policies....Commercial fisheries are often constrained by a legal framework or by regulations that are not congruent with the fisherman's perception of the world. Not only have fishermen rarely been consulted about their views of the balance between conservation and catches, but their legitimate concerns are generally treated dismissively. Furthermore, fishermen may have a detailed and accurate knowledge of the current status of the resource that forms their livelihood, but this knowledge has seldom been used in forming assessments (1993, p. 1).

It is important to understand that not all user-groups operate through an official decision-making body and thus are more easily overlooked. The cohesion of a fishing-interest group, like many aspects of fishing, varies from region to region and must be investigated during early phases of planning. For example, in the Port Canaveral area, many charter boat captains belong to a local charter boat association while commercial fishermen do not. By contrast, lobstermen in the Boston Harbor region (Berglane, 2005) belong to the Boston Harbor Lobstermen's Association. Without the presence of an organized body, fishing interests and the inclusion of fishermen in planning is more easily overlooked. As such, greater attention to the involvement of those groups without organized affiliations must be given before, during, and following dredge operation (see Brown et al., 2001 for a discussion in participatory coastal zone decision-making and measures to engage stakeholders in decision-making processes).

In his overview of the Mablethorpe to Skegness Sea Defense project in the U.K., Murray (1995) points to the mitigation measure of consulting with fishing organizations. In some areas of the U.K., where aggregate extraction activities are more intensive than others e.g., the south and east coasts of England, dedicated liaison groups have been created. For example, the South Coast Aggregates/Fisheries Liaison Group was set up in order to provide better liaison between the dredging and fishing industries along the South coast (West of the Isle of Wight to Kent), to minimize interference and to provide a forum for discussion of matters of mutual interest (an East Coast liaison group has now also been established). This group meets twice a year and provides an opportunity for the fishing industry to raise concerns and for these to be discussed in a constructive way. Zoning information is also issued at these meetings and any evidence of "out of box" dredging operations is reported by the Crown Estate. Liaison meetings of this type would potentially assist communication between fishermen and dredge operation personnel in the U.S.

Consideration to the communication needs of commercial fishermen, needs that stem from extensive time at sea and, therefore, the lack of disposable time, would facilitate the passing of information from dredge operators and local government agencies to commercial fishermen.

As with fishermen, consistent communication about the project's objectives and procedures is required through most levels of dredge operating staff. The Collier County case pointed to the possible lack of communication between all captains, between captains and crew, and/or between fishermen liaisons and operators. While this issue has not been investigated here, field research suggests an incongruity between the information disseminated to fishermen, particularly with regard to navigation routes, and the happenings at sea. This issue may point to the common ambiguity between policy and practice, one which the USACE has recognized to exist in dredging related projects:

> In this context, general policy statements endorsing integrated water systems planning, a watershed approach, and ecosystem restoration may provide little immediate practical assistance for a harried Corps project manager, regardless of his or her inclination to conduct such studies. Current barriers to more effective and consistent implementation of integrated systems planning tend to reflect the limitations of the existing decision-making framework and the presence of conflicting pressures on project planners rather than any unwillingness by the Corps to change (USACE, 2004, p. 3).

(2) Inclusion of fisheries in EIS/EA. Greater involvement of fishing concerns in all planning stages, including the EIS and EA phase, is presently lacking from the federal government's system of providing leases to a local area. In the U.S., measures for public participation are built into both the Federal application process of competitive leasing and into NEPA. In both of these processes, however, government agencies often fall short of involving the public. In the first instance, the use of non-competitive leasing is often preferred over competitive leasing. In both the cases of Brevard County and Collier County, non-competitive leasing processes were used in place of competitive leasing processes. With regard to NEPA, and as addressed above, a number of issues associated with NEPA definitions and its use also pose limitations to successful mitigation.

In general, there is a need to have an increased linkage between social and environmental impacts in interpreting NEPA and in establishing EISs. In this sense, U.S. Environmental Impact Statements tend to be reductionist in their approach, much as Sallenave describes of Canadian EIAs, "breaking down each study into various biophysical components, which are then measured and evaluated independently from one another and from the human components" (Sallenave, 1994). More specifically, Environmental Impact Statements made during the initial phases of beach nourishment lease formation should, by definition, take into account interests of user-groups, including fishermen and fishing interests. In other words, the consideration of fishermen should begin at the point of conducting EISs and EAs. Such concerns may be found etically through a social impact assessment undertaken by a researcher, or it may be found emically through the involvement of key informants from the fishing community.

In the Mablethorpe to Skegness Sea Defense case (Murray, 1995, p. 2), greater consideration of fishermen using the dredging operation's planning stage is based upon an understanding of processes that begin at the point of entrance of a dredge company/operation into the renourishment scene. Such a measure was considered to reduce a direct interference effect.

It should also be noted that in recent years, the majority of EISs undertaken in relation to marine aggregate extraction projects in U.K. waters have included dedicated commercial and recreational fisheries intensity studies. These studies, involving field-based discussions with commercial and recreational fishermen in the wider study area around the proposed dredging area, are beneficial on two main levels; (1) they enable a much more accurate overview of fishing activity in a proposed dredging area that would be obtained via desk-based review and (2) they engage the fishing community at a very early stage of the project and provide individual fishermen with an opportunity to voice their specific concerns and issues related to the proposed dredging. A similar approach for U.S. based dredging projects should be considered.

(3) Monitoring Programs. In the HSB license area, monitoring is carried out for a range of parameters, including fish resources and the fishing industry (via a log-book scheme). A monitoring program that examines effects on fish resources during and in the post-stages of a project, as well as on the fishing industry, is recommended for U.S. dredge operations to understand impacts and potentially reduce conflict. At the same time, however, it is important to note that monitoring on its own does not represent mitigation: monitoring only acts as mitigation if the results are used in a scheme of adaptive management that allows for modification of dredging practices shown to cause significant impacts.

(4) Institutional Linkages for Facilitating Future Cooperation between Fisheries, MMS, and Dredging Industry. The U.S. history of beach renourishment points to the increasing involvement of federal government agencies, such as MMS, and state government agencies, such as the Beach Management Program of the Florida Department of Environmental Protection. Further, there have been an increasing number of institutional linkages between such agencies and local agencies. At the same time, however, linkages have been limited to key players in the dredging business without attendance to stakeholders and other entities that may facilitate dredging processes and ease conflict. Recommendations for facilitating future cooperation between fisheries, MMS, and the dredging industry therefore include the following:

- Involvement of/communication with Coast Guard.
- Strengthened ties between Coastal Management agencies
- Strengthened ties with key fishing organizations, such as the Port Canaveral Charter Association of Brevard County.
- Strengthening of intra-industry ties.

The involvement of the U.S. Coast Guard (USCG) in dredge-related projects appears to be a factor in mitigating conflict, as suggested by a comparison of the two U.S. case studies. In the Port Canaveral region, the USCG has a strong presence in monitoring traffic and interaction between vessels on the water. By comparison, there is little presence of the USCG in the waters off of Collier County. According to fishermen in both locations, the presence of this entity is vital in facilitating conflict resolution. Such an institutional linkage seems particularly important in the planning stages, wherein the USCG can advise as to noted issues of the area. As part of the mission statement, the USCG is responsible for eliminating deaths, injuries, and property damage associated with maritime transportation, fishing, and recreational boating (USCG, 2006).

Strengthened ties between coastal management agencies also pose another means to facilitating mitigation of conflict in dredging areas. Communication between such local agencies could result in the sharing of information regarding the distribution of information and in the collaboration of a region-wide method for incorporating concerns of the fishing industry, and other pertinent stakeholders, into a dredging management and monitoring plan. The degree of disparity between the level of conflict in Brevard County and that in Collier County, in part, reflects disparate approaches by the two Coastal management entities in informing the public of operations.

Reflecting the mitigation measure of creating liaisons between dredge operators and fishermen noted above, the creation of an institutional link between local government agencies, dredge operators, and fishing associations is essential where available. Such linkages could facilitate information sharing and collaboration. Where such associations do not exist, it may become crucial for local government/management agencies to provide a forum where fishermen can meet and voice concerns. Through these forums, institutional linkages between fishermen, who do not belong to a formal organization, can be created.

In a sense, the creation of such forums provides for the strengthening of intra-fishing industry ties, the product of which is strong inter-industry ties. The same holds true, however, of the strengthening of intra-dredging industry communication, wherein captains are potentially out of communication with liaison officers, as the Collier County case reveals. Although the strengthening of intra-dredging industry communication is essential, it is ultimately the responsibility of dredge operators to create this level of communication.

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7.0 AUDIT TRAIL

Title : Worldwide Survey of Dredging Impacts: Literature Review			
Report No:	05/J/2/06/0051/0666/Draft_Final		
Job No:	J/2/06/0051		
Client Name:	U.S Department of the Interior Minerals Management Service		
Client Contact:	Barry Drucker		
Project Manager	Bruce Tomlinson		
Report written by	John Petterson / Jonathan Lewis / Claire Espinasse		
Report checked by	Claire Espinasse		21.06.2007
Report Authorised by	Dr. Bruce Tomlinson		21.06.2007

APPENDIX I
List of Renourished Beaches in the U.S.

Northeast Atlantic Coast:

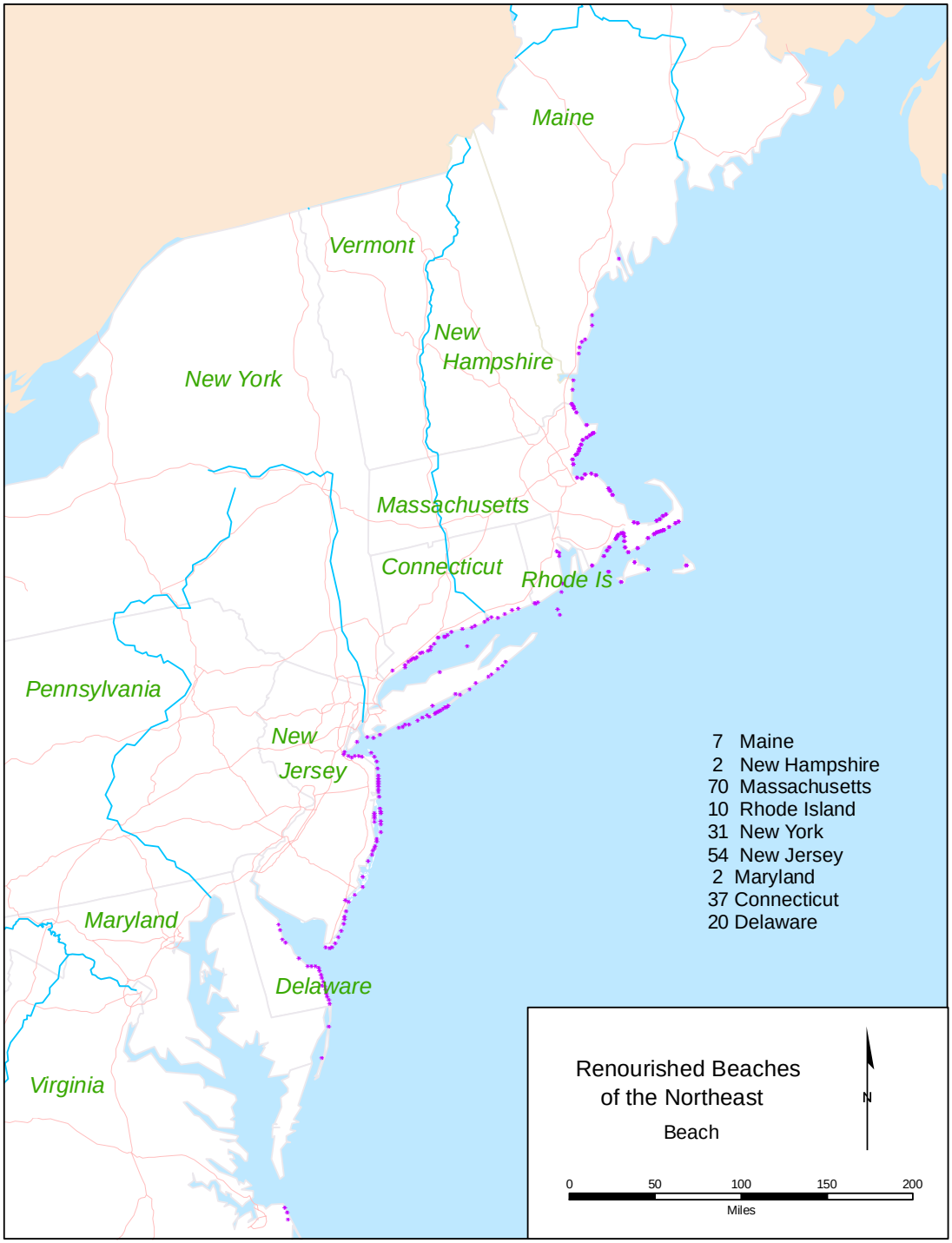

Figure I.1. Map of Northeast Atlantic Coast Beach Renourishment Sites (IAI, 2006).

Table I.1

Northeast Atlantic Coast Renourished Beach Sites

ME (7)	Pine Point		Camp Ellis	Ogonquit	Gooches Beach	Kennebunk-port	Drake & Wells Island	Woods Island Harbor
NH (2)	Hampton Beach/Harbor		Wallis Sands State Park					
NY (31)	Coney Island		Rockaway Beach	Oak Beach	Jones Beach	Gilgo Bch	Brookhaven and Islip	Great S. Beach
	Lido Beach		Mecox Bay	Sagaponack Pond	Southampton	West Hampton	Moriches Inlet	Great Gunn Beach
	Hempstead Beach		Tiana Beach	Breezy Pt.	Fire Island Pines	Point O' Woods	Saltaire	Fair Harbor
	Dunewood		Seaview	Point Lookout	Smith Point	Water Isl.	Staten Island	Robert Moses State Park
	Shinnecock Inlet		Hamlin Beach	Cedar Beach				
CT (32)	Hamonasset Park		Short Beach	Silver to Cedar Bchs.	Burial Hill Beach	Compo Beach	Prospect Beach	Seaside Park
	Sherwood Island		White Sand Beach	Calf Pasture Beach	Cove Island	Sasco Hill Beach	Southport Beach	West Silver Sands
	Fairfield Beach		Builford Point Beach	Woodmont Shore	Summings Park	Silver Meadows	Chalker Beach	Branford Beach
	Clinton Town Beach		Neptune Park Beach	Sea Bluff	Laurel Beach	Point O' Woods	Long Beach	Seaside Regional Center
	Savin Point		Esker Point	Eastern Point	Jacob's Beach			
MD (2)	Ocean City		Assateague Island					
DE (20)	Beach Cove		Beach Plum Island	Bethany Beach	Bowers Beach	Broadkill Beach	Dewey Beach	Fenwick Island
	Fort Miles	Indian Beach	Kitts Hummock Beach	Lewes Beach	North Indian Beach	North Indian River Inlet	North Shores	
	Pickering Beach	Rehoboth Beach	Sea Colony	South Bethany	South Bowers	York Beach		

Table I.1 (cont.)

Northeast Atlantic Coast Renourished Beach Sites (con't.).

NJ (54)	Atlantic City	Keansburg	Sayreville	Long Branch	Middletown-Port Monmouth	Sandy Hook	Avon by the Sea
	Union Beach	Ocean City	Cliffwood Beach	Lavallette	Harvey Cedars	Brant Beach	Island Beach State Park
	Ship Bottom	South Amboy	Laurence Harbor	Middletown-Leonardo	Avon and Belmar	Bradley Beach	Ocean Gate
	Spring Lake	Pine Beach	Avalon	Bernagat Light	Beach Haven	Berkeley Township	Brigantine
	Cape May	Holgate	Island Heights	Long Branch	Loveladies	Ludlum Bch. Island	Sea Bright
	Surf City	Barnegat Light	Bay Head	Seaside Heights/Seaside Park	Highlands	Stone Harbor	Belmar
	Middletown – Bedford	Sandy Hook	Sea Girt	Sea Isle City	Strathmere & Beesleys Point	Laurence Harbor	North Wildwood
	Longport	Upper Township	Lower Township	Deal	Shark River Inlet		
MA (70)	Quincy Shore Bch.	Dead Neck	Osterville	Plum Island	Newbury-port	Salisbury Beach	Lynn-Nahant
	Revere Beach	East Beach	West Bch.	Clark Pt.	New Bedford	Wessagussett Beach	Weymouth
	Winthrop	Town Bch. Plymouth	Town Beach Sandwich	North Scituate Beach	Osterville	Nantaskett	Oak Bluffs
	Martha's Vineyard	Chatham Harbor	Cuttyhunk Harbor	Green Harbor	Nantucket Harbor	Sesuit harbor	Pleasure Bay Beach
	Brant Rock	Buttermilk Bay	Chase Garden Bch.	Children's Beach	Collin's Cove	Dane Street	Parker's River
	Herring River	Englewood Beach	Falmouth Heights	Fishermans Beach	Forrest Beach	Front Street Beach	Germantown Beach
	Hamilton Beach	Horesneck Beach	Kalmus Park Beach	Little Harbor	Long Beach	Loop Beach	Maganset Beach
	Monument Beach	Onset Bay	Orient Height Bch.	Palmers Cove	Parkwood Beach	Pinehurst Beach	Pioneer Village
	Pocasset Beach	Pope Beach	Red River Beach	Salem Willows	Silver Shell Beach	Singing Beach	South Yarmouth Beach
	Swift Beach	Veteran's Memorial Park Beach	Water Street Beach	West Dennis Beach	Wild Harbor	Wingersheek Beach	Hull

Source: Duke University, 2005.

South Atlantic:

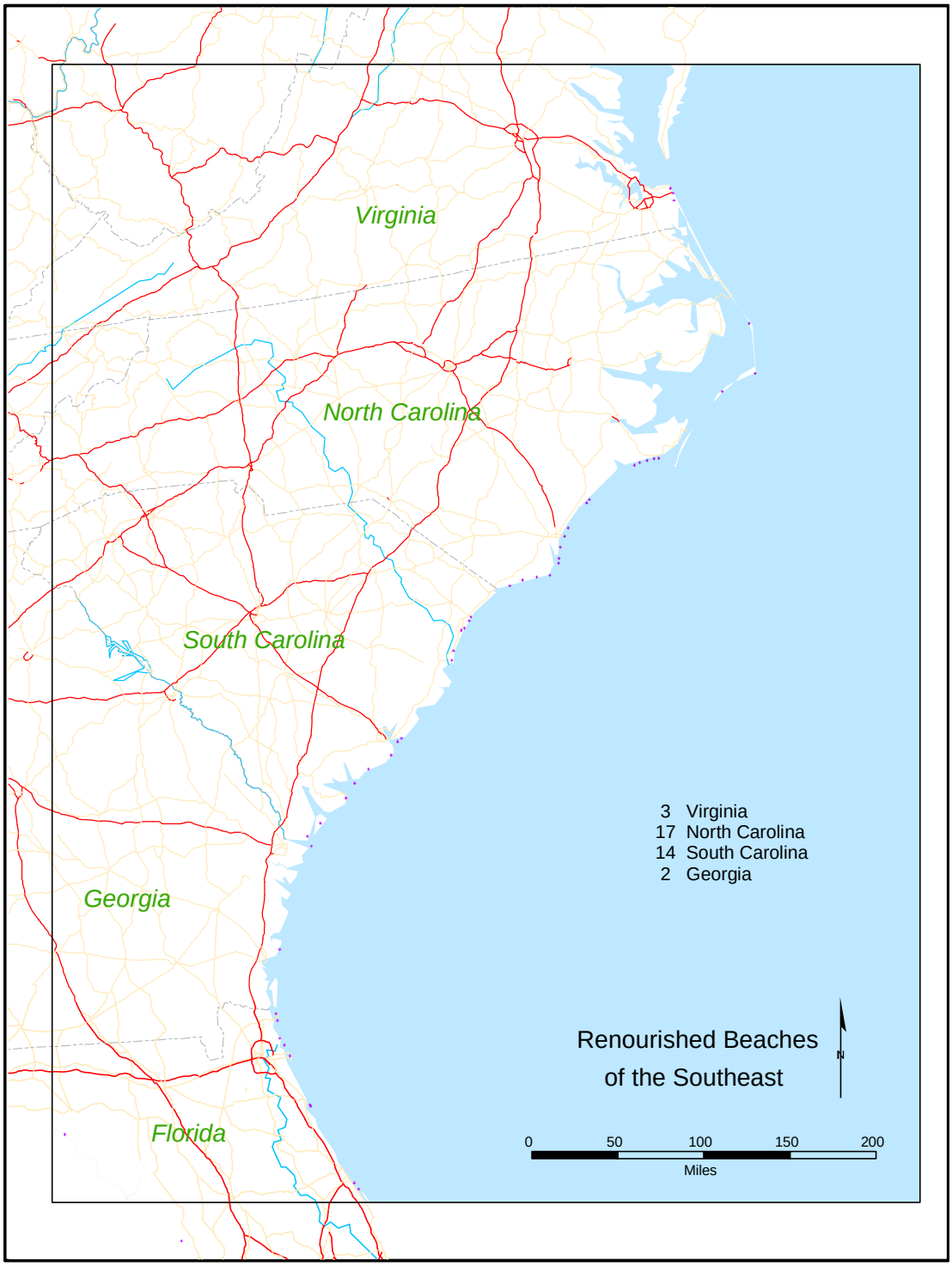

Figure I.2. Map of South Atlantic Coast Beach Renourishment Sites (IAI, 2006).

Table I.2

Southeast Atlantic Coast Beach Renourishment Sites:

VA (3)	Virginia Beach	Sandbridge	Dam Neck Naval Base				
NC (17)	Wrightsville Beach	Carolina Beach	Cape Hatteras	Fort Macon & Atlantic Beach	Holden Beach	Ocean Isle	Figure Eight Island
	Topsail Island	Emerald Island	Masonboro Island	Ocracoke Island	Pea Island	Bald Head Island	West Onslow Beach
	Kure Beach	Oak Island	Pine Knoll Shores/Indian Beach				
SC (14)	Edisto Beach	Hunting Island	Hilton Head Island	Seabrook Island	Isle of Palms	Myrtle Beach	Pawleys Island
	Debidue Island	Folley Beach	Garden City	Surfside	Daufuskie Beach	Sullivan's Island	Shore Drive
GA (2)	Tybee Isl.	Sea Island					

Source: Duke University, 2005.

State of Florida, Atlantic and Gulf of Mexico Coasts:

Figure I.3. Map of Florida State Coast Beach Renourishment Sites (IAI, 2006).

Table I.3

Florida Atlantic Coast Renourished Beach Sites

FL Atlantic Coast (48)	Lake Worth Inlet	Palm Beach	Jupiter Island	Bal Harbor	Haulover Park	Key West	Smathers Beach
	Anastasia State Park	St. Augustine	Jacksonville Beach	Pompano Beach	Lauderdale by the Sea	Cape Canaveral	Cocoa Beach
	Mayport	K. Abbey Hanna Park	Hillsborough Beach	Hallandale	Fort Pierce	Key Biscayne	Sebastian Inlet
	Delray Beach	Ponce Inlet	Virginia Key	John U. Lloyd State Park	Fernandina Beach	Vero Beach	Hollywood
	St. Lucie Inlet	Melbourne Beach	Indialantic	Amelia Island	Boca Raton	Patrick AFB	Miami Beach
	Sunny Isle	Amelia Island	Fisher Island	Jacksonville Beach	Carlin Beach	Hutchinson Island	Juno Beach
	Martin Island	Midtown Beach	Ocean Ridge	S. Brevard County	Ambersand Beach	Boynton Inlet	

Source: Duke University, 2005.

Table I.4

Florida Gulf Coast Renourished Beach Sites

FL Gulf Coast (36)	Clearwater Beach	Captiva Island	Madeira Beach	Santa Rosa Island	Anna Maria Key	Keewaydin Island	Venice Beach
	Lido Key	Mullet Key	Treasure Island	Upham Beach	Honeymoon Island	Sand Key	Bonita Beach
	Panama City Beach	Port Charlotte Beach	Gasparilla Island	South Seas Plantation	Longboat Key	Vanderbilt Beach	Perdido Key
	Apalachicola	Destin	Ft. Myers Beach	Naples/Gordon Pass	N.Redington Beach	Pensacola Harbor	Barefoot Beach
	Indian Rocks	Knight Island	Marco Isl.	Sanibel Island	Mexico Bch	St. Petersburg Beach	Bellair Beach
	St. Joseph Spit						

Source: Duke University 2005.

Gulf of Mexico:

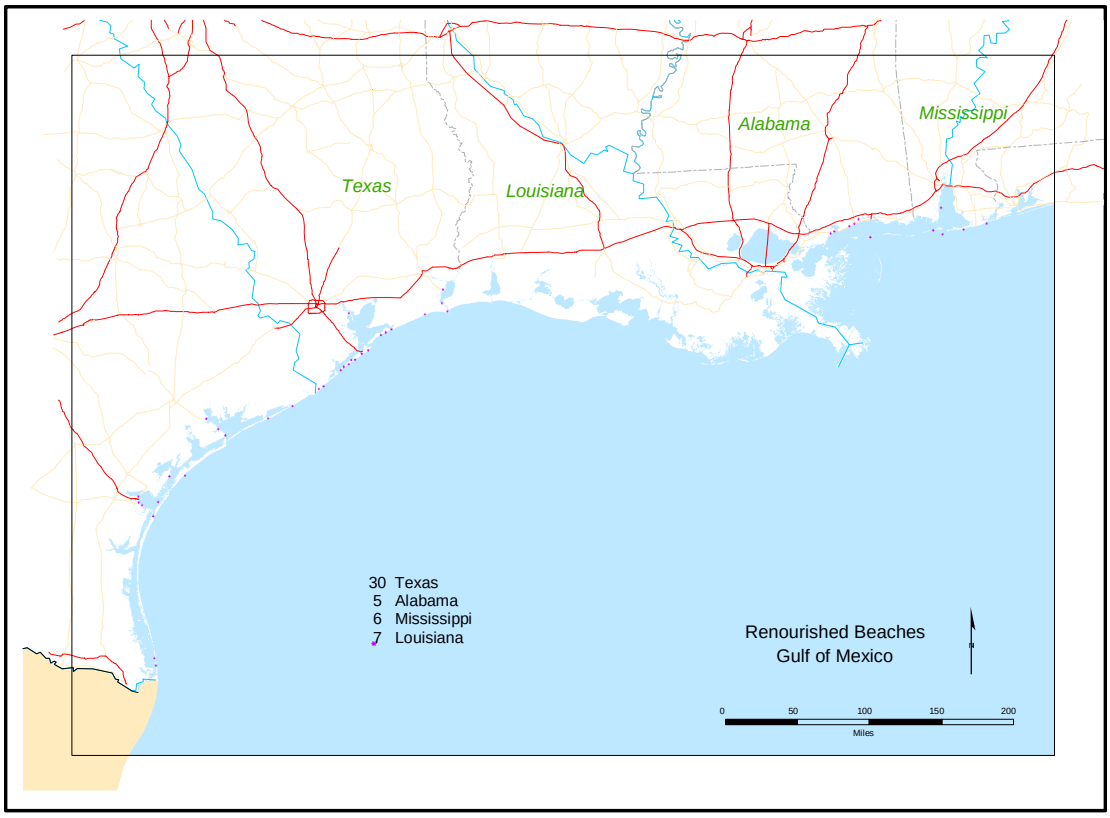

Figure I.4. Map of Gulf of Mexico Coast Beach Renourishment Sites (IAI, 2006).

Table I.5

Gulf of Mexico Coast Renourished Beach Sites

AL (5)	Perdido Pass	Sand Island Bar	Mobile Bay	Dauphin Island	Gulf Shores		
MS (6)	Bay St. Louis	City of Harrison	Waveland	West Ship Island	Gulfport	Long Beach	
LA (7)	Grand Isle	Isles Dernieres	Fourchon	Mermentau River	Freshwater Bayou	East Timbalier Island	Holley Beach
TX (30)	Galveston Seawall	South Padre Island	Big Reef Marsh	Corpus Christi Bch.	Shamrock Island	Rockport Island	Colorado River Mouth
	Mansfield Pass	Port O'Connor	Indianola Beach	Port Lavaca	Moody Gardens	McGee Beach	Rollover Pass
	Oleander Point	Sergeant Beach	Surfside Beach	Caplaen Shore	Galveston Island State Park	Bermuda Beach	West Galveston Island
	McFaddin Dune Restoration	Texas Point	Packery Channel	Pleasure Island	Highway 82 and 87	King Fisher	Morgan's Point
	Bay Harbor	Quintana					

Source: Duke University, 2005.

Pacific Northwest:

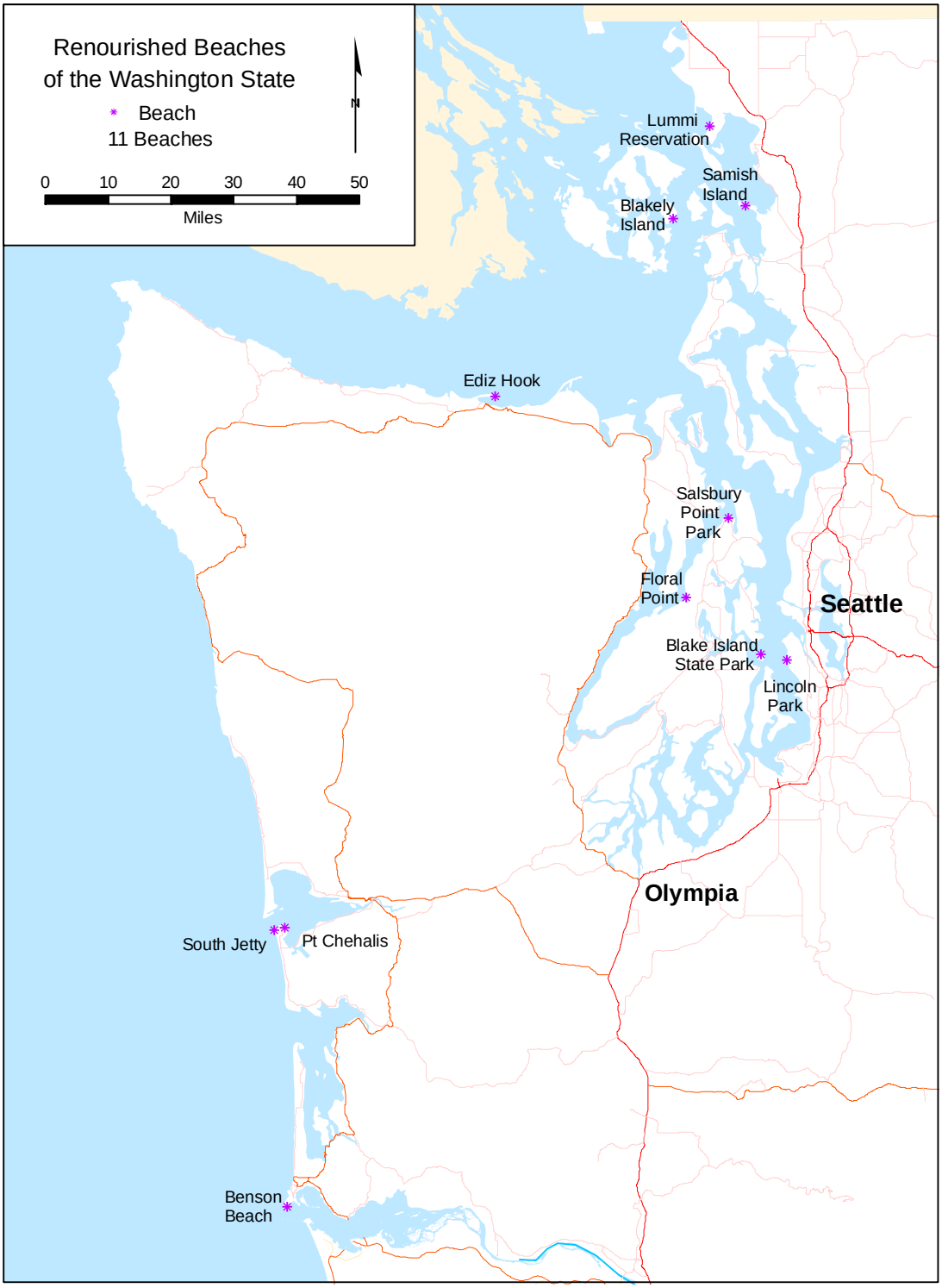

Figure I.5. Map of Washington Coast Beach Renourishment Sites (IAI, 2006).

Figure I.6. Map of California Coast Beach Renourishment Sites (IAI, 2006).

Table I.6

Pacific Northwest Coast, Washington and California Renourished Beach Sites

WA (11)	South Jetty, Gray's Harbor	Lincoln Park	Salsbury Point Park	Point Chehalis	Floral Point	Ediz Hook	Samish Island
	Driftwood Beach	Blake Island State Park	Benson Beach	Lummi Indian Reservation			
CA (45)	Bolinas Bay	Cabrillo Beach	Capistrano Beach Park	Capitola	Carlsbad State Beach Park	Coronado City Beach	Del Mar
	Delta Beach	Dockweiler Beach	Doheney State Beach Park	Doran Beach	East Beach	Gator Beach	Hueneme Beach Park
	Humbolt Bay South Spit	Imperial Beach	Las Tunas Beach	Long Beach	Long Beach City Beach	McGrath State Beach Park	Mission Beach
	Morro Bay	Morro Dunes Natural Preserve	Moss Landing State Beach	Newport Beach	North Island Oceanside Beach	Ocean Beach	Oceanside City Beach
	Pacific Beach	Redondo Beach	San Buenaventura Beach	San Onofre State Beach	Santa Monica Bay Beaches	Santa Monica State Beach	
	Seal Beach	Silver Strand State Beach Park	Silver Strand Beach	South Beach	Sunset Beach	Surfside/Sunset Beach Project	Twin Lakes State Beach
	Venice City Beach	Ventura	Whaler Island				

Source: Duke University, 2005.

APPENDIX II

List and Description of Concerns Faced by Port Canaveral Fishermen

1. ***Fuel prices:*** The present historical context associated with the international struggle over fuel resources greatly affects fishermen in Port Canaveral. The concern with rapidly rising fuel prices becomes more pronounced when compared with slowly rising, stable, or declining profits. One fisherman's comments exemplify this concern:

   > Three years ago fuel was less than half of what it is now. My fuel has gone up almost three times what it was three years ago, and I'm getting two dollars less a pound for shrimp. Even though fish prices are rising somewhat, it is not keeping up with rising fuel prices." A conversation with the local fuel importer revealed that diesel off the truck costs $1.76 and was as high as $1.91. Some smaller fishing boats are paying over $2.00 for regular gas. Diesel is almost as high per gallon as the fishermen get for some smaller shrimp per pound. As little as three years ago, diesel was $0.60 to $0.70 per gallon.

2. ***Insurance rates****:* Insurance rates have climbed to a point that many fishermen can barely afford it. For example, all older wood-hulled and steel-hulled boats cannot obtain insurance at any price.

3. ***Operation costs****:* As with fuel and insurance, all other costs related to operating boats, such as electronics, gear, and maintenance have increased significantly, thus making work in the fishing industry less profitable and more stressful.

4. ***Storm water run-off into the lagoon system:*** Related to the above concern is that rapid development of the area poses a threat to the lagoon systems and estuaries, which serve as natural nurseries for the area. Storm water run-off from the developed areas and roads into threatens fish larvae and krill, especially during rainy seasons.

5. ***Dumping of spoil material offshore anywhere:*** Spoil from port channel dredge operations are brought to a dump site located within state waters, just south of the port entrance. All dumping, even within a designated location, is a source of concern for many fishermen. One charter captain commented: "Placing dredge spoil offshore from Port Canaveral causes drastically reduced waster clarity. The reef is being smothered by the clay which precipitates out. This phenomenon was not noticed before the placing of dredge spoils off the east coast of Florida".

6. ***Protection of the Thousand Islands area from development:*** The Thousand Islands are a complex of islands located in the Banana River east of Cocoa Beach. These islands serve as a feeding ground, nesting ground and habitat for a number of bird and fish species. County-wide development has posed a threat to these natural environments.

7. ***Imports and the competing prices:*** Prices on shrimp have lowered within the past three years, according to informants. Shrimp that were sold for $5.60 to $5.75 per pound are now selling for roughly $3.00 per pound. Much of this is due to foreign imports, particularly those that escape tariffs. According to one informant, "Shrimp prices haven't gone up in 10 years and, as you know, our costs have gone up a lot".

8. ***Lowered quality of life resulting from development****:* Brevard County has grown rapidly with the recent county-wide building and has created concern in the general quality of life. This item pertains to anything believed to be of lower quality as a consequence of development.

9. ***Regulations that create bi-product waste*****.** Because fishermen must abide by regulations that limit size and species, they are forced to throw back all undersized fish or non-targeted species caught (and often killed) in their nets. One fisherman illustrated, "By-catch laws only let them keep 50 pounds of flounder, the rest they throw away. He added, "It's such a waste".

10. ***Dockage:*** Dockage is a central concern of both commercial and charter fishermen, but especially for commercial fishermen. "Dockage for commercial vessels is either too expensive or non-existent," noted one commercial fisherman. A charter captain reported that in 1974, the price of dockage was $74.00 a month. Presently, it is $300.00 a month. Although this is expensive, he points out, it is lower than in Fort Pierce, where it is $500.00 a month. Many have the fear that, as land becomes more valuable, dockage space will be lost. Near the port, one large marina was sold and turned into condominiums with dockage for private condo owners. *Bluepoints Shrimp House* is turning all of its commercial dockage into charter boat and recreational boat dockage. As such, the concern is a real and pressing one.

11. ***Over-restricted security zones, in port and outside of port:*** Because the port is located proximal to NASA and to two large military bases, fishermen are continually monitored and checked while on sea by security officials. One charter captain summed up the concern in his free-list: "Creating more and more security areas in and around the port which is making it harder and hard to cast bait nets for our offshore fishing". Another charter captain feels these security zones infringe on his rights as an American and the traditional water-uses of the area: "We, as charter boat captains of Port Canaveral, are no longer allowed to catch bait in the traditional areas – due to new security measures. We are Americans, federally licensed with photo ID; there is no reason to exclude us from these areas."

12 ***Little or bad promotion:*** Commercial fishermen believe that the industry receives unfair or negatively-biased media coverage. One gill netter listed "bad news coverage not based on fact" as a concern, while a commercial shrimper listed "commercial fishermen getting a bad reputation from propaganda by wealthy sport fishing interests and 'elite' sectors of society".

    At the same time, charter fishermen feel that they do not receive sufficient press. Charter fishermen are aggressively trying to self-promote themselves but complain of not being able to organize themselves enough. They feel that they are not getting any cooperation from the cruise line companies or Port Authority. The charter industry has to pay the cruise line to place brochure advertisements in their reception areas only; no promotional material is allowed on cruise ships.

13. ***Lack of artificial reef development:*** Several artificial reefs exist inshore of the natural reefs offshore. Many perceive, however, that greater artificial reef development could mean a larger fish population, less competition with other fishermen in the same location, and, further, potentially less distance to travel to reach a fishing location, as most artificial reefs are located within ten miles of shore.

14. ***Not enough regulation/enforcement offshore.*** Some of the charter captains that felt regulations offshore were not enforced complained about illegal long-liners. One headboat captain said he has found illegal long lines set on every reef he has fished: "I've pulled them up with my anchor and many of my clients have snagged them with their lines when bottom fishing the reefs." He said there is no one out along the reefs to stop them. Another head boat captain complained about recreational fishermen keeping fish under size. He said when they come out on his boat, they say they "never threw them back before".

15. ***Too many regulations***. This item refers to the number of federal and state regulations placed on fishermen, both in terms of licensing and in terms of restricting catches. Charter fishermen on the whole feel as though regulations placed upon them exist as a means to create unnecessary red-tape. Commercial fishermen in general feel that more and more regulations are making it harder to make a profit. One commercial sharker colored a picture of the situation: He was unable to catch many shark during the permitted season this winter due to stormy weather; now the season is closed: "The beaches are closed off from Juno to Fort Pierce because there's so many black tips, but we can't fish for them. It doesn't make sense".

16. ***Availability of launching ramps and haul-out areas:*** Development within Brevard County has caused an increase in land-prices and consequently competition for space. Larger, more profitable operations are beginning to replace the struggling businesses within the port. For one fisherman, the closing down of the marinas is a sign of the times to come, and related to the loss of haul-out areas. "Loss of unloading facilities is due to the take-over by other commercial interests, such as tourism. Disney is a prime example." For recreational fishermen, this was the number one concern. The two recreational fishermen who opted to complete a protocol listed "ramps for boaters" and "continued support for the public ramps" as a key concern.

17. ***Restricted use of the West Basin for catching bait****:* The West Basin is a docking area for many cruise ships and has been a long-time bait catching area for charter and commercial fishermen. Since 9/11, no one is allowed to fish for bait if a cruise ship is at dock. Fishermen are allowed to enter for bait fishing if the docks are empty, but this rarely occurs.

18. ***Pressure from/conflict with other types of fishermen (commercial, charter, recreational diver).*** Commercial and charter fishermen occasionally feel pressure from other types of fishermen. Charter and head boat captains, for example, complain of "illegal long-lining" and over-ambitious commercial divers. A party boat captain complains, "Commercial divers harvesting snapper and grouper with power heads dramatically reduces the amount of fish we see."

19. ***A plan to develop spotted trout and red fish hatcheries like those in Texas:*** Texas has been successful with the development of hatcheries for spotted trout, red fish, and other species of fish, and consequently it has become a model for many people concerned about declining fish populations. People in the Port Canaveral region feel that Banana River lagoon system would be ideal for a similar hatchery and would help increase fish size and numbers released into both the rivers and the ocean.

20. ***Boat traffic (Casino, cruise, dredges, etc.)****:* One of the concerns listed was difficulty coming into and exiting out of the port as a consequence of heightened port traffic over the past two decades. Large cruise ships have become a particular concern since the mid 1980s, when they first occupied the port, and even more so since the post-9/11 increased security. The increase in cargo ship traffic is also a concern. As large craft enter or exit the port, smaller vessels must give right of way and stay clear.

21. ***Water clarity on reefs****:* Several fishermen expressed concern over the water clarity on the reefs. Many of those who voiced this concern believed the source to be the spoil material from the port dredge operation. They felt that the sludge deposited inshore moved to the reefs farther out by way of currents and storm tidal surges. They feel the reef complexes are being suffocated.

22. ***Closure of Canaveral bight****.* The Canaveral bight is the area south of Cape Canaveral, adjacent to the shore and just north of the port entrance. Because it is presently located in the Security Zone, which was created as a result of 9/11, fishermen are no longer able to enter this area. It has been traditionally used as a source for charter and commercial bait. It is also an excellent place to drag for white shrimp, to fish for shark, and to fish with small tackle.

23. ***Car parking*****:** The problem with car parking arises when clients of charter boats cannot find parking or when they use Casino Boat parking. Although there is a large parking area along the south side of the port, the rate of development in the area and growth in user-groups (particularly recreational fishermen), there has become a supply/demand dilemma.

24. ***Limited number of seafood dealers:*** Presently, the port supports four seafood dealers; three shrimp houses and one fish house. At one time, there were many more, which made competitive pricing more of an advantage to the fishermen. The smaller number of dealers has also changed the face of the port, which is now more charter-oriented and less commercial-centered.

25. ***Dredging of offshore shoals that break up heavy seas:*** Similar to the concern over the potential creation of potholes from dredging is the concern that too much sand taken from the shoals could result in a change in bathymetric conditions. Although this concern was stated using the language of the respondent, it was revealed afterward that the concern was with a hypothetical condition, a situation that could potentially arise in the event too much sand were taken. Fishermen did not know how much sand was being removed in the operation.

26. ***Smell at the Port entrance***: A strong stench is noticeable at the entrance of the port, and several fishermen complain about this. The smell comes from a mulch pile of hurricane debris located west of the Port Authority (Figure II.1).

Figure II.1. Mulch pile at Port (IAI, 2006).

27. ***Reopening the Sykes Creek area:*** Sykes Creek north of the barge canal, located west of the port along Highway 528, was bought and closed for protection by Environmentally Endangered Lands (EELS). One fisherman listed as a concern.

28. ***Reopening the Pine Island area on Merritt Island:*** Pine Island, located on the Indian River north of the harbor, is also an area bought and closed for protection by EELS.

29. ***Port channel dredging:*** "The on-going dredging and dumping of dredge materials offshore, which is covering up our offshore reefs, wrecks and structures, and creating muddy waters offshore". A commercial diver has noticed in the past five to ten years sandy bottom areas near the reefs becoming covered with silt and mud.

30. ***Development and the lack of places to fish from the shoreline****:* Concomitant with the development boom in Brevard County has been the increasing building of condominiums along ocean and river-fronts, thus reducing the number of places people can fish from shore.

31. ***Availability of wash-down water****:* This was a very central concern of recreational fishermen. It results from the Port Authority's recent removal of wash-down water due to the sense that it was being abused.

32. ***Change in inshore currents from potholes****:* One respondent stated that inshore currents could potentially be altered from the "potholes" that are left behind after port dredging. Although he felt potholes do not currently exist, the potential for the situation to arise is present.

List and Discussion of Primary Concerns as Identified by Fishermen in Collier and Lee Counties

1. ***Fuel Prices.*** Nation-wide and global trends in fuel prices set by international economics have been heightened by the impacts of Hurricanes Katrina and Rita (2005) on the oil and gas industry in the Gulf of Mexico. The rising cost of fuel is the main concern cited by all fishermen, across the board.

2. ***Boat Traffic.*** The number of vessels in the Naples and Vanderbilt areas reportedly concerns both commercial and recreational fishermen. Shrimpers and recreational fishermen point to recreational boat traffic as a problem, while dredge traffic is the primary concern of crab fishermen and shrimpers. These fishermen assert that dredge traffic interferes with fishing navigation routes and areas. Crab fishermen contend they are unable to pull trap lines because they cannot predict where the dredge path will be from day to day. Crab fishermen also contend that they have lost an average of 50 percent of their traps to dredges.

3. ***Water Quality***. Fishermen are concerned that chemicals contained in the runoff from nearby farms end up in the near-shore waters of Collier County, thereby potentially depleting local stocks. Red tide is also a concern.

4. ***Dredge Operation***. Among all fishermen, the dredge operation for the Collier County beach renourishment project was, on average, a significant source of concern. Their primary concerns are with dredge traffic, restricted communication, potential depletion of fish stock, and damage to equipment. Concerns about dredging were greatest among crab fishermen and least among recreational fishermen.

5. ***Seafood Prices and Foreign Imports***. Nationally, the low wholesale market prices for seafood, due to foreign imports and increased competition, have created slimmer profit margins for fishermen. Since the turn of the century, prices paid for wholesale seafood have dropped dramatically. This is a concern among commercial fishermen, who must deal in the open market.

6. ***Dredge Site Deterioration***. This is primarily a concern for charter fishermen who are fishing for black grouper at the dredge site, as it is a spawning ground.

APPENDIX III[8]

Stipulations Set Forth in the Negotiated Noncompetitive Lease for Sand, Gravel and Shell Resources on the outer Continental Shelf, Awarded to Collier County, Fl

Stipulation No. 1 – Post Dredging Hydrographic Surveys of the Ocean Borrow Site

Stipulation No. 2 – Endangered and Threatened Species under the National Oceanic and Atmospheric Administration (NOAA) Fisheries Jurisdiction

Stipulation No. 3 – Endangered and Threatened Species under the Fish and Wildlife Service (FWS) Jurisdiction

Stipulation No. 4 – Calculation of the Volume of Sand Placed

Stipulation No. 5 – National Oil and Hazardous Substances Pollution Contingency Plan

Stipulation No. 6 – Archeological Reporting Requirement Plan

Stipulation No.7 – Use of Electronic Positioning System Dredge and Transmittal of Location and Production Information to the Lessor

Stipulation No. 8 – Submittal of Project Completion Report to MMS

Stipulation No. 9 – Submittal of all Copies of Project Data to the Lessor required under Florida's Joint Coastal Permit NO. 0222355-001-JC

[8] Source: U.S. Department of Interior, Mineral Management Service. 2005a. Negotiated Noncompetitive Lease for Sand, Gravel and Shell Resources on the Outer Continental Shelf. Department of Interior, MMS. Washington D.C.

APPENDIX IV

Task 1: Literature Review